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The papers in this document represent preliminary results of a study which is part of a 3-year project being conducted by the Educational Testing Service in cooperation with the New York City Board of Education, with support from the Carnegie Corporation of New York. This document is divided into seven sections: (1) Introduction, (2) Classification Skills, (3) Time Sequence Task, (4) Preschool Children's Understanding of the Coordinated Concepts of Distance, Movement, Number, and Time, (5) A Study of Number Conservation in Young Children, Under Two Materials Conditions, (6) Children's Understanding of Basic Language Structure, and (7) Discussion: Cognitive Growth in Preschool Children. A bibliography is included at the end of each section. (WD)

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COGNITIVE GROWTH IN PRESCHOOL CHILDREN

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A symposium presented at the annual meeting of the American Educational Research Association, Chicago, Illinois, February 10, 1968.

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COGNITIVE GROWTH IN PRESCHOOL CHILDREN

1. INTRODUCTION

Richard S. Melton

This symposium was organized to present some preliminary results of an intensive study of the cognitive growth of preschool children, specifically four- and five-year-olds. The study is part of a three-year project being conducted by Educational Testing Service in cooperation with the New York City Board of Education and with support from the Carnegie Corporation of New York. This project grew out of an earlier cooperative project with the New York City Board of Education which resulted in a new approach to the assessment of the intellectual skills of first-grade children. The nature of that approach was reported on here two years ago (Bussis & Melton, 1966; Tanaka, Campbell, & Helmick, 1966), and it is now in use in almost all first-grade classes in New York, as well as in various other communities throughout the country. While an understanding of that procedure would help to provide a backdrop for this symposium, time will not allow me to say more than that it is a multifaceted assessment procedure leaning heavily on Piagetian theory and utilizing teacher observation, test-like exercises and assessment tasks such as Piaget's conservation of quantity problem. Some of you may know this approach under the name "Let's Look at First Graders."

The current project was begun in an effort to expand the "Let's Look at First Graders" approach to preschool children, and one of the first steps was to gain some information about the course of cognitive growth in what Piaget would call the preoperational or prelogical child. With the counsel of an Advisory Panel of which William Kessen is chairman and Eugene Gollin, our

discussant, is a member, an integrated study of four cognitive areas was conducted in New York City schools last year. The four areas chosen for study were: classification skills, time concepts, transformations, and language. Possibly our use of the term "transformations" needs a word of explanation. Basically what we are referring to is the matter of change--what changes and what remains invariant when there is a transformation or change in the environment. The number conservation problem is one illustration, and spatial transformations and time-distance relations represent another type of transformation. The nature of the measures developed in this area will be clearer when Barbara Rothenberg and Lewis Pike report on their results shortly.

Seven tasks were developed to sample from these four cognitive areas, and we will report on all but one of them today. But first a word about the design of the study and the sample. The age range with which we were concerned was from four years to six. We wanted approximately half boys and half girls, and we wanted equal representation from the lower socioeconomic class and from the middle class. The initial emphasis was on a cross-sectional design in which children at selected ages were sampled. These ages were at three-month intervals between four and six years of age. A three-month interval was chosen because we also wanted to do a limited longitudinal study, retesting each child once following the same interval of time as that between the groups in the cross-sectional study. The initial cross-sectional testing was done in the January to March period (1967), and as a consequence we were unable to get any children at the lowest age interval, 4-0 (four years zero months) when the testing began. Thus the basic cross-sectional design was a two by two by eight--two sexes, two socioeconomic levels, and eight age groups, 4-3, 4-6, 4-9, ... 6-0.

The sample of children was drawn from four public schools and two private nursery schools in New York. Two of the public schools were in low SES areas of Harlem and Brooklyn, and in these schools we obtained four-year-olds from Headstart classes and five-year-olds in kindergartens. The other two public schools were in middle class areas--Queens and the Bronx--and in these we could obtain only kindergarten children. Therefore, to get four-year-old middle class children we made arrangements with two private nursery schools, both in the Bronx.

Each of the participating schools was assigned one or two pairs of what we came to call our examiners--women specially selected and trained by us to administer the measures we had developed. After a period of visiting in the classrooms to build rapport with the prospective subjects, the examining team took each child in the sample to a separate room for testing. One woman presented the task to the child while the other observed and recorded his responses. Between four and eight testing sessions were required for each child, each session lasting from 20 to 30 minutes. All testing on each child was completed in four weeks or less, and the seven tasks were administered to all children in a standard order. All children were tested by examiners of the same racial background as themselves, except for 24 Puerto Rican children who were tested by Negro examiners.

While the original design called for a total N of 320 (10 children in each of 32 cells), and while we originally scheduled substantially more than 320 children for testing, in some of the schools we encountered a variety of problems, and we ended up with usable data for 259 children. Table 1-1 gives the cell frequencies. The one cell having no subjects was lower class female,

Table 1-1

Numbers of Children of Each Sex Tested at Each Age Level and SES Level

(Total N=259)

	Low SES		Middle SES	
Age	Boys (N=47)	Girls (N=69)	Boys (N=70)	Girls (N=73)
4-3	2	0	9	4
4-6	5	7	8	6
4-9	5	12	7	8
5-0	7	12	5	13
5-3	7	8	12	12
5-6	7	11	14	8
5-9	6	7	8	11
6-0	6	12	7	11

age 4-3. There simply were no girls at this age in the two schools in which we were working.

Of the 259 children, 70 did not complete one or more of the tasks, but rather than restrict the analyses just to those who had complete protocols, it was decided to utilize all subjects who had data relevant to each analysis.

One additional feature of the study has been omitted so far. In addition to the seven tasks we prepared, each child was administered the Peabody Picture Vocabulary Test (PPVT) as the final performance measure. This was included in the battery (1) to provide descriptive information, (2) to provide a baseline measure so that results could be compared to those of other studies, and (3) to provide a possible covariate.

The results on the Peabody were somewhat unanticipated. While scores were not available for 32 of the 259 children, the data available indicated that the middle class four-year-old group had a mean raw score only half a point lower than the middle class five-year-olds. Translated into IQ's this meant a nine-point difference in favor of the four-year-olds (see Table 1-2). This makes interpretation of age difference results for the middle class sample complicated, but we are endeavoring to pull apart the various interrelationships by a variety of procedures.

In the lower class sample the Peabody results created less of a problem. Both the four- and five-year-olds had average IQ's of approximately 72.

With these introductory remarks, we are now ready to turn to a brief presentation of the major results. While responsibility for work on each of our measures was in most cases shared by a team of two or more staff members, only one member will report here today, and of course only part of the results

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Table 1-2

Means and Standard Deviations of Peabody Picture Vocabulary Test IQ Scores

(Total N=227)

	Low SES		Middle SES	
	Pre-K (N=41)	K (N=58)	Pre-K (N=48)	K (N=80)
$\bar{X}$	72.22	72.57	110.60	101.99
S.D.	24.62	26.77	13.37	16.59

can be presented in the time available. As further analyses of both the cross-sectional and longitudinal data are completed, they will be reported in the literature.

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Bussis, A. M , & Melton, R. S. Piaget for first grade teachers: A guide for understanding intellectual development. Research Memorandum 66-9. Princeton, N. J.: Educational Testing Service, 1966 (Read as a paper at the annual meeting of the American Educational Research Association, Chicago, Illinois, February 1966.)

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2 CLASSIFICATION SKILLS

Rosalind Charlesworth*

The ability to classify and categorize items in the environment is an important cognitive skill. Categories serve as a form of shorthand for summarizing information in a manner that is meaningful to the person classifying and to other people. Development of classification skills also seems to be a precursor of the development of conservation skills (Sigel, Roeper, & Hooper, 1966; Wohlwill, 1967) The research to be reported here focused on the development of classification skills in four- and five-year-old children

The Task

The task materials consisted of the array of 24 objects shown in Figure 2-1. Some of the objects were "real" (such as a pen, pencil, and crayon), some were life size representations (such as plastic fruit), and some were miniatures of real objects (such as hats, family members, and a cow) The objects were selected with cross-classifications in mind so that a variety of sorts were possible using principles such as function, shape, color, generic class name, etc. (See Table 2-1)

The first type of task required the child to perform sorts using single objects as clues. For each sort a clue object was placed on a sheet of white paper and the child was instructed: "You put some things on the paper that you think belong with this." After the completion of each trial the child

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Figure 2-1

Objects Used in the Classification Task

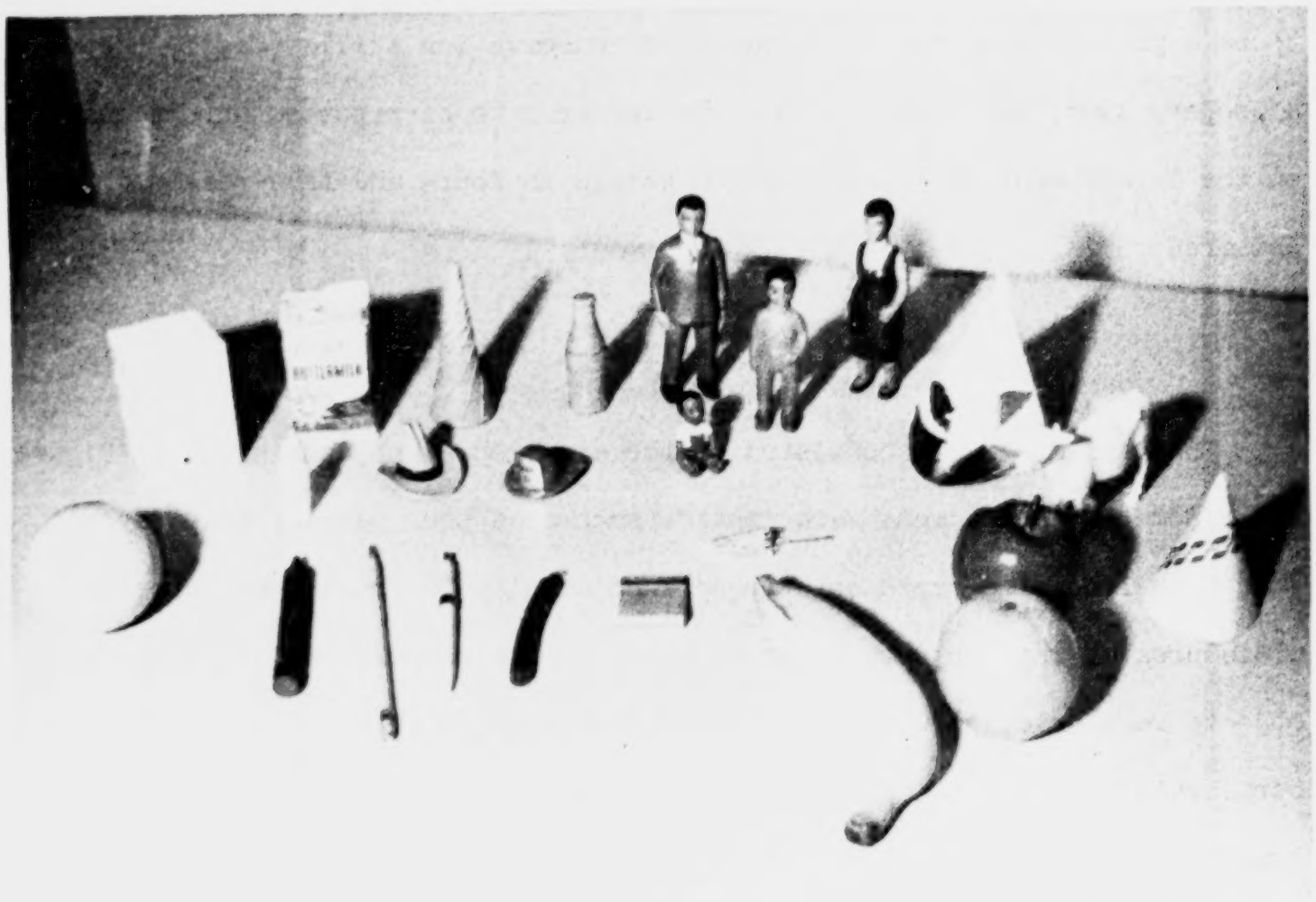

Table 2-1

The Array of Classification Task Objects and Possible Organizational Principles

	Possible Organizational Principles			
Object Clue	Shape	Class	Other	Color
Sort 1 Red Crayon[a]	candle	pencil, pen	matches	fire hat, apple, candle, duplicate crayon, boy's shirt, man's tie, woman's lips, baby's lips
Sort 2 Milk Carton	apartment building	baby bottle, dixie cup, soda bottle	cow	apartment, baby bottle, cow, cup, and green and yellow appearing incidentally on other items
Sort 3 Yellow Party Hat	dixie cup, ice cream cone	cowboy hat, fire hat	umbrella	banana, pen, umbrella, woman's blouse
Sort 4 Orange Fruit[a]	ball	apple, banana		duplicate orange, match cover, ball, pencil, soda bottle
Sort 5 Man Doll		woman doll, boy doll, baby doll		

[a]Duplicate available

was asked to tell why the things belonged together. The clue items were a red crayon, a small milk carton, a yellow party hat, a plastic orange, and a rubber figure of a man. For two of the sorts, the crayon and the orange, an identical match was available in the choice array. After each sort the objects were randomly replaced in the array. The objects included in these five trials were presented in Table 2-1.

On the second type of task (trials #6 and #7) double clues were offered--an orange matchbook and an orange pencil in one instance (#6) and a banana and an ice cream cone in the second (#7). The child was instructed: "Put things on the paper that belong with both of these."

On the third type of task, the child was presented verbally with three sorting principles and asked to sort according to these principles--"All the things that are red" (#8); "All the things you can write or draw with" (#9); and "All the things that are food" (#10).

The series of tasks was designed to tap preferential sorting, ability to abstract a common property of two objects, and ability to sort when presented with a verbal clue. We were interested in exploring available and preferred organizational schemes using tasks of differing levels of difficulty.

Response Coding

Single Object Clue Sorts

The categories used for classifying responses to the single object clue sorts are a combination of those used and discussed by other investigators (Bruner & Olver, 1963; Goldman & Levine, 1963, Inhelder & Piaget, 1964; Vygotsky, 1962). They are presented in Table 2-2. The responses were

Table 2-2

Codes Used in Categorizing Classification Task Responses in Single Object Clue Sorts (Sorts 1-5)

Organizational Principles	Organizational Approaches
Color	Universal Rule
Shape	Edge Matching
Material	Keyring
Conceptual	Logical Multiple Grouping
Functional	Geometric Constructions
Associational	Piling
Numerical	Logical Grouping plus Piling
Common-unessential	Irrelevant Grouping
Autistic	Irrelevant Grouping plus Piling
Thematic	No Objects
Direct Match	
Mixed	
Semi-autistic	
Logical Labeling	
No Reason	

classified under two major headings, (1) Organizational Principle and (2) Organizational Approach. Under the first were included classes based primarily on the child's verbalized reason for his sort with secondary consideration given to the actual objects chosen. The categories include logical reasons such as color, shape, function, etc. and nonlogical reasons such as "because," "I don't know," "they belong," etc. Under Organizational Approach were included classes of responses based primarily on the child's method of object choice as determined from considering the objects chosen by the child with secondary consideration given to his reason. The approaches include the use of one universal rule, multiple groupings, piling, etc.

Double Object and Demand Sorts

The double object clue sorts were each coded correct or incorrect. The verbal demand sorts were coded separately for number of appropriate and inappropriate objects selected and in one case (red) the number of marginal objects (such as the doll with red lips). Also recorded was a code indicating whether the child chose all appropriate objects, all inappropriate objects, or a mixed collection.

Results and Discussion

Single Object Clue Sorts

As can be seen in Table 2-3 the coded categories under Organizational Principles and Organizational Approaches were consolidated, on the basis of a priori judgment, into maturity levels: three levels of Principles and four levels of Approaches. Tables 2-4 and 2-5 give the percentages of total response output at each level for each grade and SES group.

Table 2-3

Definitions of Levels of Organizational Principles and Approaches

Organizational Principles		
Level	Definition	Principles Included
A	Most mature; logical reasoning is used.	Mature Color Responses, Shape, Conceptual, Functional, Associational, Material, Numerical
B	Some degree of logical reasoning used.	Mixed, Common-unessential, Immature Color Responses, Thematic, Direct Match, Labeling
C	Immature, no logical reasoning used.	Autistic, Semi-autistic, No Response

Organizational Approaches		
Level	Definition	Approaches Included
A	Most mature; all objects fit one rule.	Universal Rule
B	Less mature but show logical thinking.	Edge Match, Keyring, Multiple Group
C	Begin with logical approach but digress.	Logical Group plus Piling
D	Immature; no logical grouping related to the clue object.	Illogical Group, Geometric Construction, Piling, Illogical Group plus Piling, No Group

The middle SES children (Table 2-4) used more Level A (most logical) Principles than did the lower SES children. Within each SES group the kindergarteners used more Level A Principles than did the prekindergarteners. Within Level A the low SES prekindergarten children gave mostly Color and Associational Principles, the low SES kindergarteners Color, Associational, and Shape; the middle SES prekindergarteners Conceptual, Shape, Color and Associational, and the middle SES kindergarteners Color, Associational, Conceptual, and Functional. There is, then, an increase in variety of mature responses and in the percentages of mature responses with higher SES and with higher age.

Within the group of Principles designated as Level B (some evidence of logical thinking) all groups give between one-third and one-half immature color responses (e.g., saying "same color" when the objects are several different colors). The second most dominant response in this category for the lower SES children is the Direct Match and for the middle SES children the Mixed category kind of answer. The low SES children seem more prone to make the most obvious choice at this level. The middle SES children tend to have a chain of responses any one of which might be a mature response in itself.

More Level C responses (no evidence of logical thinking) are given by both groups of low SES children than by either middle SES group, while within each SES group the younger children give the larger percentage of immature reasons.

The same kinds of trends in regard to social class and age differences appear for the kinds of Organizational Approaches used (Table 2-5). Level A responses (Universal Rule Approaches) are more frequent for the middle SES children, but there are no age differences within social class. Within the

Table 2-4

Percentage Distributions of Maturity Levels of Organizational Principle Responses[a]

Principle Maturity Level	Low SES		Middle SES	
	Pre-K (N=230)	K (N=290)	Pre-K (N=245)	K (N=410)
A	21	30	37	41
B	22	27	26	31
C	57	43	37	28
Total	100	100	100	100

[a]Responses were summed across five sorts; thus N's refer to number of responses.

Table 2-5

Percentage Distributions of Maturity Levels of Organizational Approach Responses[a]

Approach Maturity Level	Low SES		Middle SES	
	Pre-K (N=230)	K (N=290)	Pre-K (N=245)	K (N=410)
A	18	18	28	30
B	37	39	25	33
C	17	24	25	25
D	28	19	22	12
Total	100	100	100	100

[a]Responses were summed across five sorts, thus N's refer to number of responses.

Level B approaches the Keyring type accounts for most of the responses for the low SES group and consists of more Direct Match-Keyring combinations than in the middle SES sample. The middle SES group used both Keyring and Multiple Groupings for the most part. Very few children in either group used Edge Matching. The lower SES prekindergarten children less often than the other three groups of children started out with a logical group and then added extraneous objects (Logical Group plus Piling). For all four groups most of the Level D (immature) sorts were pilings. The middle SES kindergarteners gave the smallest percentage of piling responses. Thus as logical responses increase with SES level the number of prelogical decrease with both SES and age.

A comparison of the combinations of organizational Principles and Approaches used by each of the four major subgroups of subjects is presented in Table 2-6. The trend is for the more mature level Principles to combine with more mature level Approaches. That is, children who use the Universal Rule Approach usually give Level A Principles. Children who pile usually give Autistic or Semi-autistic reasons or no reason at all. The middle SES children use the Universal Rule-Level A combination more frequently than do the low SES children. At the other extreme the low SES prekindergarten children use the most Level D Approaches combined with Level C Principles. When the low SES prekindergarten children do use a Universal Rule Approach, nearly half the time they can't, or at least don't, give a logical reason. About one-third of the time the low SES kindergarten children are unable to, or at least don't, give a logical reason when using the Universal Rule Approach.

Table 2-6

Percentage Distributions of Principle and Approach Maturity Level Combinations[a]

	Low SES					
	Prekindergarten (230 responses)			Kindergarten (290 responses)		
	Principle Level			Principle Level		
Approach Level	A	B	C	A	B	C
A	8	3	7	11	1	7
B	12	13	11	15	16	8
C	1	5	12	2	8	14
D	2	1	26	2	2	14

	Middle SES					
	Prekindergarten (245 responses)			Kindergarten (290 responses)		
	Principle Level			Principle Level		
Approach Level	A	B	C	A	B	C
A	24	0	3	11	1	7
B	10	11	3	15	16	8
C	2	7	16	2	8	14
D	2	5	16	2	2	14

[a]Responses were summed across five sorts, thus N's refer to number of responses.

Verbal Clue Sorts

The responses to the three Verbal Demand Clue Sorts are summarized, with respect to appropriateness, in Table 2-7. On all three sorts the low SES prekindergarten children gave the smallest percentage of All Appropriate Sorts. The low SES kindergarteners did more Appropriate sorts than the low SES prekindergarteners on all three sorts, but less than both middle class groups on sorts 9 and 10 Only on Sort #8 (red) did the low SES kindergarten group give a larger percentage of All Appropriate Sorts than the middle SES prekindergarteners. It may be that the ability to label colors correctly is more strongly dependent on age and/or amount of school experience than are the other categories. Of the few children who picked no appropriate objects at all, most were low SES prekindergarteners.

Double Object Clue Sorts

The percentage of children achieving correct answers on the double clue sorts was quite small. As can be seen in Table 2-8 both low and middle SES children who answered #6 correctly used predominantly color responses on sorts #1-5. These children also usually gave a color answer on sort #7. Very few children answered both items correctly The evidence strongly supports the interpretation that most of the children who gave the correct answer on #6 were compulsive color sorters who accidentally hit on the correct response because they generally gave "color" answers on each item.

Relationships to Language Measures

Two aspects of these data suggested that it might be profitable to examine the relationship between the performance on these classification tasks and

Table 2-7

Percentage Distributions of Responses to Verbal Clue Sorts (Sorts 8, 9, and 10)

Descriptive Category	Low SES Pre-K (N=49)	Low SES K (N=57)	Middle SES Pre-K (N=50)	Middle SES K (N=83)
1. Sort 8 (red)				
All appropriate	19	56	40	60
Mixed	72	41	58	40
No appropriate	9	3	0	0
No response	0	0	2	0
Total	100	100	100	100
2. Sort 9 (write)				
All appropriate	30	54	74	71
Mixed	51	41	22	22
No appropriate	13	5	4	6
No response	6	0	0	1
Total	100	100	100	100
3. Sort 10 (food)				
All appropriate	53	75	86	81
Mixed	36	24	14	16
No appropriate	6	1	0	2
No response	5	0	0	1
Total	100	100	100	100

Table 2-8

Relationships between Use of Color Principles

on Sorts 1-5 and Answers on Sort 6

	Answer frequencies			
	Low SES (N=106)		Middle SES (N=133)	
Answer on sort 6	Color not used	Color used	Color not used	Color used
Correct	9	24	2	29
Incorrect	47	11	80	14
	$\chi^2=25.69$, $p < .001$		$\chi^2=63.95$, $p < .001$	

measures of verbal facility. First, in order to receive credit for a Level A Principle, a child must have the verbal skills required to give a logical coherent answer. Second, among the low SES children there were many Semi-autistic-Universal Rule combinations. This combination indicates a child used a Universal Rule Approach but was unable to state a logical reason.

The following comparisons of Classification performance and verbal facility were made. The correlation between Peabody Picture Vocabulary Test raw score and the total numbers of mature principles used was computed; the r was .41 ($p < .001$). In Table 2-9 are presented means, standard deviations, and the ranges of scores on the Verbal Instructions Task (VIT) and the Language Comprehension Task (LCT) from our test battery for both the dominantly mature and dominantly immature sorters on sorts 1-5. On both language measures the mature sorters had consistently higher mean scores and usually higher, narrower score ranges. If the middle class children are assumed to exhibit optimum four- and five-year-old behavior, the poorer performance by the low SES children (who dominated the ranks of the immature sorters) undoubtedly is at least a partial function of their less adequate language skills.

Conclusions

As has been pointed out innumerable times, the results of any psychological research are partly a function of the method of measurement. In the measurement of classificatory behavior the results obtained are particularly dependent on the number and kind of competing stimuli offered in the choice array and on the clue offered or directions given (Birch & Bortner, 1966; Ricciuti, 1966). In our tasks we offered the child a variety of competing

Table 2-9

Means, Standard Deviations, and Ranges of Verbal Instructions Test and Language Comprehension Test for Mature and Immature Sorters at Two Grade Levels

Verbal Instructions Test				
	Prekindergarten		Kindergarten	
	Immature (N=61)	Mature (N=27)	Immature (N=45)	Mature (N=48)
$\bar{X}$	18.92	19 85	18.29	20.52
S.D.	3.18	3.14	3.58	2.91
Range	9-24	14-25	10-24	10-26

Language Comprehension Test				
	Prekindergarten		Kindergarten	
	Immature (N=48)	Mature (N=32)	Immature (N=61)	Mature (N=49)
$\bar{X}$	14.58	15.75	14.92	15.90
S.D.	3.15	2.57	2.44	2.20
Range	7-20	10-20	10-20	10-20

stimuli which remained essentially the same with only the clue varying, in order to elicit the child's available and preferred sorting procedures. It is important to point this out since previous investigators so often have pitted only two or three preferences against each other or have used smaller choice arrays with fewer possible categories With the Single Object Clue Sort our goal was to elicit as wide a variety of available preferred sorting strategies as possible. With the Verbal Demand Sorts we wished to find out if a selected group of sorting categories was available to the children and if they could sort accurately according to the rules given. These objectives seem to have been accomplished with some success. The Double Clue Sorts were either too difficult or were not good measures of the ability to abstract a sorting rule from more than one item. Goldman and Levine (1963) did find that with objects presorted into larger groups, kindergarten children were able to abstract universal rules for some of the object arrays presented.

As expected, when given a verbal clue the children had less difficulty in sorting out appropriate objects than when given an object clue. That is, they had more difficulty when they had to decide on a sorting rule for themselves.

There are clear developmental differences between age groups for the low SES children. These differences are less consistent for the middle SES children, but there may be some confounding because the middle SES prekindergarteners had a considerably higher mean PPVT IQ score than the middle SES kindergarten children. As a group, however, it can be seen that both the four- and five-year-olds were beginning to be able to abstract higher order categories from an array of strongly competing stimuli.

The results present some implications for the educational process. The SES differences for both verbal and nonverbal response items are striking The low SES children were less competent in their problem solving. They had a higher percentage of mixed and inappropriate responses to the verbal clues and they used fewer Universal Rule Approaches. They also used fewer higher level reasons (principles). Coupled with the result that the immature sorters group (which would contain more low SES children) had lower scores on the two language measures these facts lend support to the current feeling among educators that young low SES children need compensatory educational programs if they are to compete with their middle class counterparts.

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3. TIME SEQUENCE TASK

Masako N. Tanaka

Many of the studies on the development of time concepts in young children have been interested in the child's subjective interpretation of temporal events. Fraisse's (1963) comprehensive survey of a large number of such studies (e.g., perception of order, duration, estimation, etc.) suggests that an awareness of time duration appears at about three or four years of age. However, the young child's subjective perception of duration is highly dependent on the use of the time interval so that his judgment is affected by the quantity of work accomplished or the amount of effort expended. Even as late as five years of age, the concept of a unit of time as being independent of its content is still a difficult problem.

The concrete approach to the idea of time is also evidenced by the child's confusion of spatial dimension with temporal dimension. The investigations of Piaget (Flavell, 1963) and Lovell and Slater (1960) indicate that a five-year-old will watch the movement of two cars and agree that they both started and stopped at the same time. However, if one car covered a greater distance, the child will insist that it had been traveling a longer time than the other car.

In Piaget's (1955) view, the child's gradual acquisition of temporal understanding involves a conceptual grasp of both the temporal order of succession and of the temporal intervals between succeeding temporal points. Of the two types of understanding, the temporal ordering of events was considered to be particularly appropriate to the needs of the present study. The use of pictorial sequences has a direct relationship to the academic curriculum with its emphasis on the comprehension of story sequences. At the same time, it is apparent that this particular type of sequence understanding may be greatly

influenced by the child s previous experience with the type of presentation and the level of verbal skills available to the child. The awareness of this problem led to the development of a series of tasks which would permit the assessment of both verbal and nonverbal types of ordering performance.

Task Description

The Time Sequence Task used in the present study was designed to assess the young child s understanding of time as represented in a pictorial sequence. The materials consist of 13 sets of cards with black and white and colored cartoon-type drawings, including three instructional items and 10 test items. In addition, there are two rectangular white boards divided into sections of three and four spaces and these "answer boards" are used to position the cards during the testing session.

It was assumed that the kind of sequential ordering performance required by some of the tasks would be unfamiliar to many of the children in the group, and so the "warm-up" or instructional period was planned with some care. In order to orient the children to the use of a left-to-right progression in the arrangement of a sequence, the examiner first read from a "special book" made of cardboard pictures clipped together. She then took the pages apart and placed them in order on the answer boards so that they presented the child with a left-to-right sequence. She explained that by doing this, all the pictures could be seen at the same time in the proper order. The pages were then reclipped again into a book form and the child was asked to unclip and replace the separate cards on the answer board. There were two such "special books" available for instructional purposes, but most of the children, i.e.,

90% of the low SES and 92% of the middle SES group, were successful with the first "book." This was a surprising finding in view of the large amount of time devoted to the development of this skill in the usual academic curriculum. The child was then asked to perform the same ordering procedure on a pile of three cards by selecting the appropriate sequence of pictures while listening to another story. The warm-up session concluded with the child retelling the story and the examiner eliciting responses when necessary. This last activity was particularly helpful with the less verbal group of Puerto Rican children in the study. Through the use of these various activities, there was some assurance that the children would understand the instructions for the test items.

Results and Discussion

The performance on the 10 actual test items was considered from the point of view of the total task score and the scores on the four parts (representing four types of items) of the test. Each item had a total possible score of two points, with some items having a partial score. The analysis on the total scores indicated that there were significant differences due to the variables of age ($p < .02$) and SES ($p < .001$). As shown in Table 3-1, the five-year-olds were superior to the four-year-olds and the middle SES children performed better than the children in the low SES group.

Use of Verbal Cues

The test items were divided into four parts or item types which required different kinds of performance within the structure of a sequence presentation. The first item type investigated the ability of a child to use linguistic cues

Table 3-1

Means, Standard Deviations, and Ranges

on Total Score on Time Sequence Task[a]

	Low SES		Middle SES	
	Pre-K (N=42)	K (N=52)	Pre-K (N=41)	K (N=80)
$\bar{X}$	10.19	11.62	12.78	13.55
S.D.	4.15	2.94	2.64	3.01
Range	1-19	5-18	7-19	5-20

[a]The values in this table may be slightly in error because the responses of a few children on two items were not recorded by the examiners (see footnote, Table 3).

Figure 3-1

Set of Cards for "Linguistic Cues"

Actual card size: 5½" X 4½"

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in the construction of a sequence. The child was asked to listen to a story and to arrange a sequence of picture cards to match the events in the story. As shown in Figure 3-1, the cards were designed so that there was no intrinsic ordering within the pictured situations and the child was dependent on the use of verbal cues as given in the story. The scores on this task indicated significant differences for SES ($p < .02$) and the interaction of this variable with sex and age ($p < .04$). The information in Table 3-2 indicates that the middle SES children had higher scores than the low SES group, but there were sex differences within each SES group. Within the middle SES, the girls were superior to boys at both age levels. In the low SES, the boys did better in the older group whereas there were no sex differences in the younger group. Another way of saying this is that the teacher of a group of five-year-olds from this study would have found that if the class was a middle SES group, the girls had higher scores, but if the class was a low SES group, the boys gave a superior performance.

Verbal Recall and Transfer

The second type of item required two kinds of performance: verbal recall and a nonverbal transfer. In the verbal recall portion of the item, the child was asked to listen carefully to a story because he would be asked to repeat the "same" story later. The interest was, of course, in the child's translation of the phrase: "the same story." As the interviewer told the story, she placed the picture cards in front of the child in sequence and then asked him to repeat or retell his version of the "same" story. These cards were then left in position and the child was asked to "match" this original sequence with a parallel set of cards. This portion of the task was considered a

Table 3-2

Means and Standard Deviations on Item 3,

Following Verbal Cues

	Low SES				Middle SES			
	Pre-K		K		Pre-K		K	
	Boys (N=16)	Girls (N=26)	Boys (N=24)	Girls (N=28)	Boys (N=18)	Girls (N=23)	Boys (N=41)	Girls (N=39)
$\bar{X}$	1.38	1.38	1.67	1.36	1.56	1.83	1.76	1.95
S.D.	0.93	0.92	0.75	0.93	0.83	0.56	0.65	0.32

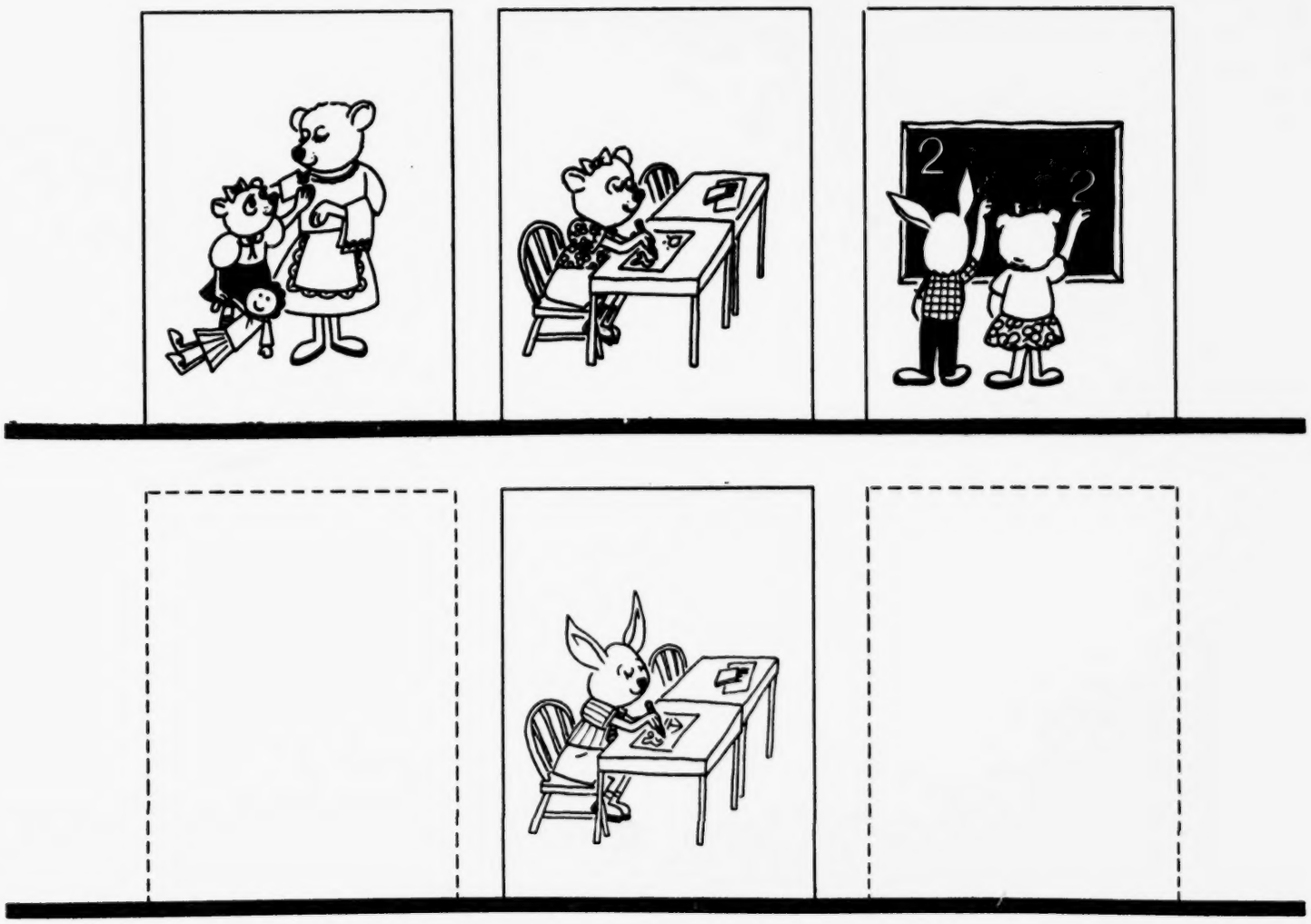
nonverbal transfer task in that no verbalization was required of the child with the reproduction of the sequence shown in the first part of the task.

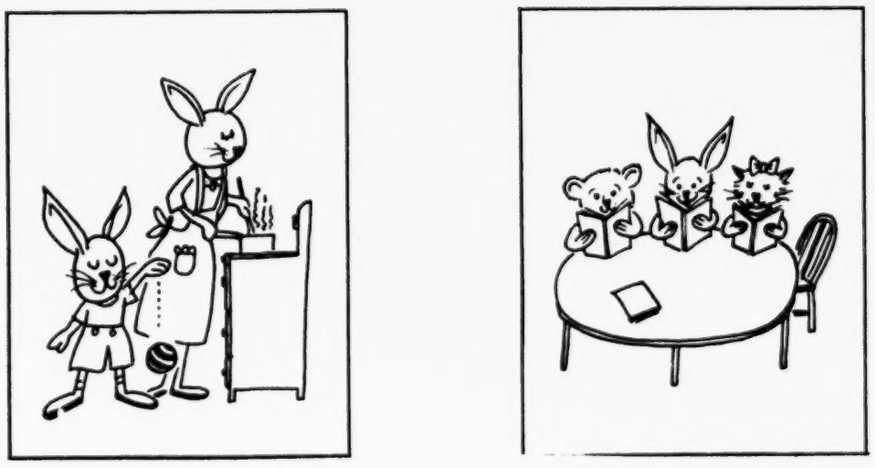
There were two such items using three and four cards, and the three-card sequence on Susie Bear is shown in Figure 3-2. As the examiner told the story, the appropriate card was placed in order in front of the child. For the first card, the accompanying statement was: "Last year Susie Bear was a little bear and stayed home with her mother." The second card was presented with the statement: "This year Susie Bear is in kindergarten and she likes to draw pictures." The last episode was described with the remark: "Next year Susie Bear will be in first grade and she will work with numbers." During the transfer portion of the task, the second card of Robert Rabbit was placed under the corresponding card for Susie Bear, and the child was asked to place the remaining two cards in the appropriate positions.

The verbal recall portion of the item was scored in two ways: whether the child followed the original sequence in the retelling of the story and whether the time words used were either exact or appropriate transformations. The scores given in Table 3-3 are for the first kind of score, i.e., the reference to the original sequence, and these scores show no apparent SES difference in the kindergarten group but some differences in the prekindergarten group. Although there were significant age differences ($p < .001$), most of the difference is evident in the comparison between the prekindergarten and kindergarten children in the low SES group. Interestingly enough, there were no sex differences on this type of performance which required a general verbal statement as to the original ordering of events

Figure 3-2

Set of Cards for "Verbal Recall and Nonverbal Transfer"





Actual card size:
$5\frac{1}{2}$" X $4\frac{1}{4}$"

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Table 3-3

Means, Standard Deviations, and Ranges

on Items 4b and 5b, Story Retelling[a]

	Low SES		Middle SES	
	Pre-K (N=28)	K (N=44)	Pre-K (N=35)	K (N=77)
$\bar{X}$	2.71	3.81	3.77	3.81
S.D.	1.62	0.71	0.63	0.58
Range	0-4	0-4	2-4	2-4

[a]The values in this table may be slightly in error because 12 responses on item 4b and 14 responses on item 5b were not recorded by the examiners.

Use of Time Words

The actual stories used in the verbal recall or story retelling portion of these tasks had been structured around the use of words related to time, and these "time words" were analyzed separately. The three-card sequence used the terms, "last year," "this year," "next year," and the four-card task used the words, "morning," "noon," "afternoon," and "night." Each of the cards used in a sequence was "tagged" with one of the words and we were interested in observing the levels of time words and the transformations made by the child in his retelling of the "same" story. The interviewers were asked to record as much of the child's story as possible with particular reference to the time words and their transformations. The possibility of inaccurate recording must thus be considered in the interpretation of the analysis of these verbal responses. At the same time, it is of interest to note that the analysis of weighted scores showed significant differences for Sex ($p < .03$) and SES ($p < .001$). The words used by the child were weighted in terms of the kind of transformations, e.g., "specific," "appropriate," "general," and "inappropriate." In spite of the request for the "same story," a few children still insisted on using the traditional approach of "Once upon a time...." As shown in Table 3-4, the verbal performance of the girls was superior to boys at both age levels and both social class levels and the middle SES children did better than the low SES group. In other words, the middle SES girls had the highest scores followed by the middle SES boys, the low SES girls, and the low SES boys.

The above finding was in contrast to the performance on the nonverbal sections of the tasks which showed a significant interaction of Sex x Age ($p < .05$) in that although the girls were superior in the younger group, the boys had

Table 3-4

Means, Standard Deviations, and Ranges

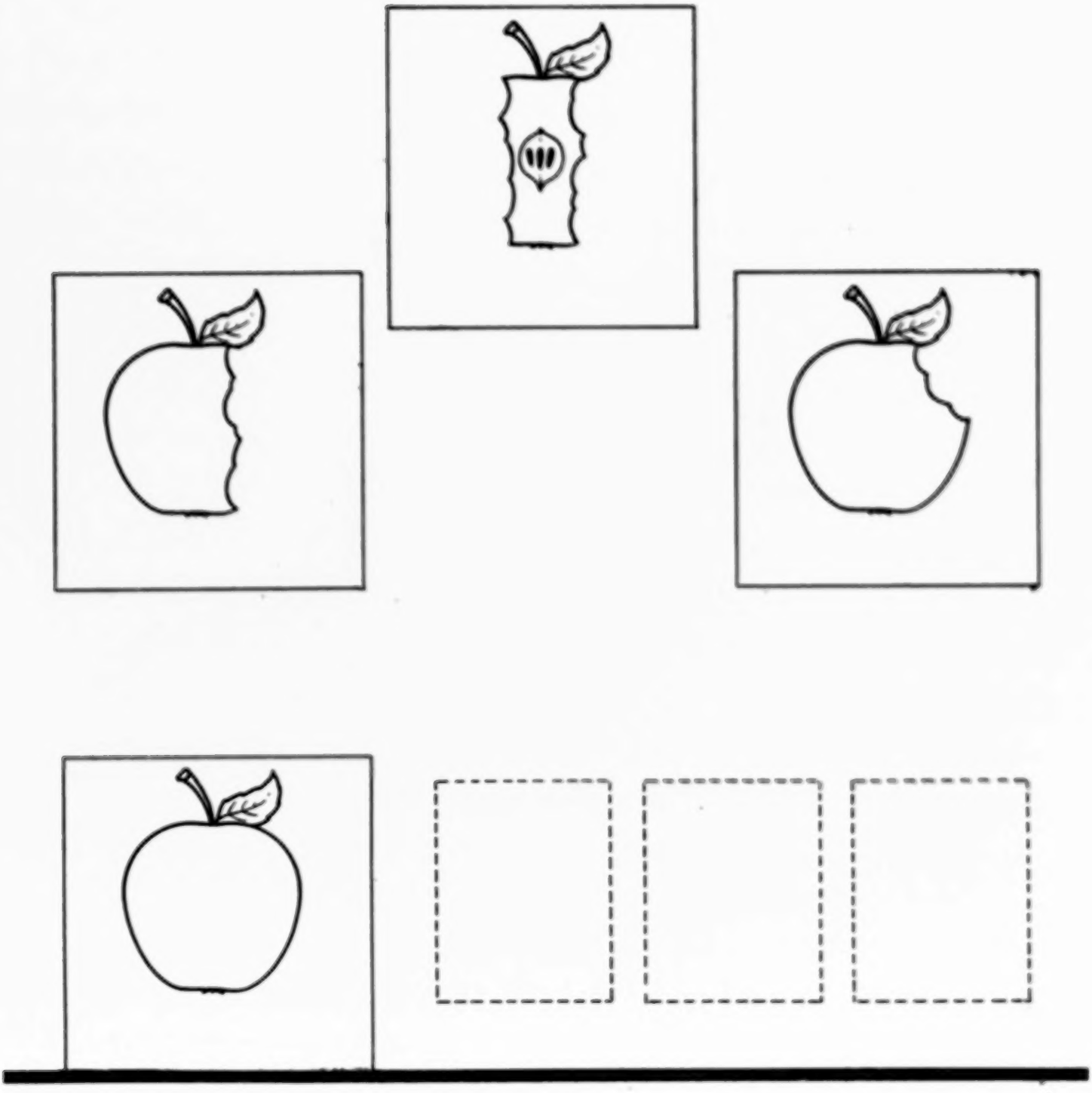
on Items 4b and 5b, Time Words

	Low SES				Middle SES			
	Pre-K		K		Pre-K		K	
	Boys (N=31)	Girls (N=19)	Boys (N=22)	Girls (N=23)	Boys (N=14)	Girls (N=19)	Boys (N=38)	Girls (N=36)
$\bar{X}$	2.31	2.63	2.23	4.74	6.29	7.47	6.74	7.61
S.D.	3.31	3.05	2.39	3.50	4.46	5.81	4.29	4.47
Range[a]	0-12	0-11	0-9	0-11	0-14	0-18	1-18	0-18

[a]Weighted scores, possible range: 0-21.

Figure 3-3

Set of Cards for "Imposing Order"



Cards shown actual size

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higher scores in the older group. It was also in contrast to the earlier analysis which showed no sex differences in the ability to verbally order the correct sequence. It appears that it was only when a child's story was analyzed for the exactness of the words used in recall that there was a sex difference in the response.

Imposition of Structure

The third type of item required the child to impose structure on a set of cards without the presentation of verbal cues. As shown in Figure 3-3, the child was given the first card in a four-card series showing the stages of an apple from the whole apple to the apple core and was asked to order the remaining three cards in the series. Partial credit was given for the correct placement of the final card. The results showed that the older children made significantly higher scores than the younger group and the middle SES was superior to the low SES group. Table 3-5 indicates an interesting comparison between the percentages of children who placed all cards correctly and those who placed only the last card in the correct position. The comparison of total and partial scores within each SES group indicates that the low SES children had a higher proportion of partial scores, whereas the middle SES groups had a higher percentage of completely correct scores.

Sequence Completion

The last four items in the test were sequence completion items, in which the child was asked to choose one of three answer choices for the final card needed to finish the sequence. There were two three-card sequences and two four-card sequences, and the analyses of the results showed that SES was the

Table 3-5

Percentages of Total and Partial Scores

on Item 6, Imposing Order

Score	Low SES		Middle SES	
	Pre-K	K	Pre-K	K
2 (all cards correct)	4	22	39	46
1 (end card correct)	25	24	22	26

Table 3-6

Percentages of Correct Responses

on Four Sequence Completion Items

Item	Low SES		Middle SES	
	Pre-K (N=41)	K (N=52)	Pre-K (N=41)	K (N=50)
7	20	29	51	66
8	49	38	34	38
9	46	37	66	69
10	46	58	61	64

Figure 3-4

Set of Cards for "Sequence Completion"

Actual card size: 5½" X 4¼"

only significant variable. It is interesting to note that this variable had much greater effects for the longer four-card sequence as compared to the three-card tasks ($p < .001$ vs. $p < .047$). As shown in Table 3-6, in three out of four items, the middle SES groups ranked 1 and 2 and the low SES groups ranked 3 and 4. The items giving the low SES group the most difficulty were Item 7, shown in Figure 3-4, and Item 9, which involved the sequence of two rabbits going down a slide.

The use of a multiple answer choice presentation permitted the structuring of distractors so that it was possible to look at the type of errors being made by the children. In each of the four items, the three answer choices consisted of the following: the correct answer, the duplicate of the first card in the sequence, and the answer which was correct except for a perceptual discrepancy, e.g., different color. In the three-card sequence shown in Figure 3-4, the first two cards were placed in position and the child was asked to choose one of the three answer choices (including the perceptual distractor of a purple banana peel). Tables 3-7 and 3-8 show the percentages of responses to the two wrong answer choices. In six out of eight comparisons between kindergarten and prekindergarten children (i.e., four items for two SES groups), there was a higher percentage of younger children selecting the choice with a perceptual discrepancy, whereas there was a higher percentage of older children who preferred to use the repeat of the first card as a distractor choice.

Table 3-7

Percentages of Children Using Perceptual Distractor on Items 7-10

	Low SES		Middle SES	
Item	Pre-K (N=41)	K (N=52)	Pre-K (N=41)	K (N=80)
7	39	27	17	10
8	37	38	32	26
9	24	37	24	19
10	34	15	24	14

Table 3-8

Percentages of Children Using First Card in the Sequence as a Distractor on Items 7-10

	Low SES		Middle SES	
Item	Pre-K (N=41)	K (N=52)	Pre-K (N=41)	K (N=80)
7	39	44	32	24
8	12	23	34	36
9	27	27	10	13
10	17	27	15	22

Summary

The results of the Time Sequence Task offered some interesting information on significant age and SES differences in the performance of young children on various types of pictorial sequences. The sensitivity of the total task to such differences was further defined by their role in each of the four types of tasks. The pervasive effect of SES differences was observed in all of the four types of items with the exception of part of the Verbal Recall Task. The age differences were most distinct in the task requiring the imposing of order on a set of cards, and there were some indications that the age differences were more striking within the lower SES group.

Although the overall task performance showed no significant sex differences, there were some interesting differences on the types of items which involved the use of language skills. The level of "receptive" language skill as observed in the "Use of Verbal Cues" item suggested that sex differences may vary with the SES level, i.e., the girls in the middle SES were superior at both age levels, whereas the boys in the lower SES were superior at the five-year-old level. The level of "productive" language skill in the Verbal Recall item indicated that there was no sex difference in the general productive language ability to recall a story in the correct sequences, but there was a difference in the exact productive language used in telling the "same" story.

The findings in this study were helpful in identifying some of the variables which may affect performance on a sequential ordering task. It was assumed that such ordering skills are an integral part of the development

of time concepts in young children. The theoretical basis for this assumption implied a need for further research into the study of temporal duration and interval. It is suggested that these aspects of time understanding may also be studied through the use of pictorial sequences, and it is hoped that this type of research will be a logical extension of the findings of the present study.

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4. PRESCHOOL CHILDREN'S UNDERSTANDING OF THE COORDINATED CONCEPTS OF DISTANCE, MOVEMENT, NUMBER, AND TIME

Barbara B. Rothenberg

A general concern with children's understanding of the spatial environment has long been apparent in education and measurement. This interest is most frequently seen in the extensive use of mazes and their equivalent to teach children to plan ahead, to find the most direct and correct route between places, as well as other skills.

A somewhat different approach to the study of this area introduces the notion of comparison between two routes in contrast to one route with many alternatives. The two-route approach to the concepts of distance and motion has been investigated by Piaget (1946) and Piaget, Inhelder, and Szeminska (1960) and has led to the conclusion that when children were observing the movement of objects through space, those at the preoperational level tended to center exclusively on the spatial order of terminations, i.e., they attended to which object ended up ahead of the other. These children neglected the positions of departure, and, even more essential for understanding distance, they did not appear to consider the sum of the spatial units contained between the departure and the termination points (Flavell, 1963).

Based on these observations, a task was developed to gain detailed information on the nature of preschool children's judgments of distance. Past research has shown that assessment of distance understanding must also involve other basic concepts which are closely related such as movement, time, and number.

Method

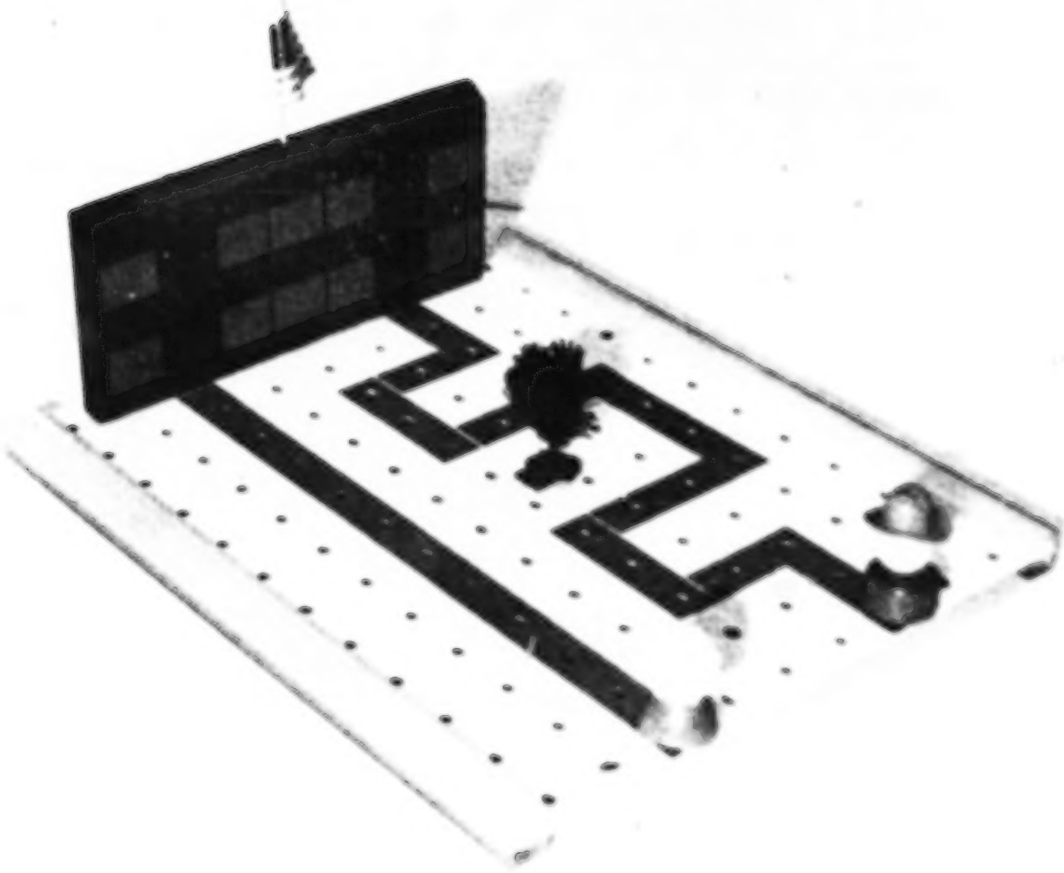
The situations and materials, devised to be interesting and meaningful for preschool children, are pictured in Figure 4-1. Distance understanding was assessed with the use of a pegboard frame on which were taped two paths to a schoolhouse. This schoolhouse was a three-dimensional model built on small pegs which could be fitted into holes at either end of the path. Peg dolls were placed on the paths, and the children were told that the dolls were going to walk to school along their respective routes. The pegboard allowed the pacing of the dolls on their routes. One path was straight and contained 10 holes and the other path was crooked and contained 20 holes. The paths did, however, have identical end points. The distance between the holes was the same in both paths, one inch. Each child was able to choose the dolls to play the game from an array of eight dolls of equal size, half Negro and half white as well as half male and half female. These possibilities were provided so that the subjects could play with dolls with which they would probably be comfortable.

The task itself was made up of a series of problems, most of which measured three kinds of responses. These were: (1) predictions, (2) reasons or explanations, and (3) descriptions. In addition to the evaluation of children's understanding of distance and related concepts, the task also provided some instructional probes and hints for the child so that he had an opportunity to learn as he went along.

In most of the problems, the subject was asked to predict which of the two routes or paths involved more traveling. Specifically, the child was asked "Do you think one doll (or child) will get to school before the other?"

Figure 4-1

Materials Used in the Distance Task



If he thought so, he was asked, "Which one?" Then, the subject was asked the question, "Why is that?" The examiner then moved the doll on the long path and the subject moved his doll on the short path The two dolls always left at the same time and the examiner tried to keep her doll walking at the same rate as the child's doll, which wasn't always easy When the dolls had been moved, the child was asked to describe what happened and then usually asked why the dolls ended up where they did. After each of these problems, some questions were asked of the child which tried to emphasize the essential cue of number that was necessary for the child's complete understanding of the presented situations. These questions generally required the subject to compare the number of steps each doll took in relation to how far the dolls actually got toward their goals.

The four different types of problems which were presented to the children are shown in Figure 4-2. With some slight variation, each problem was presented twice to the child to provide some estimate of his ability to learn and generalize from prior experience.

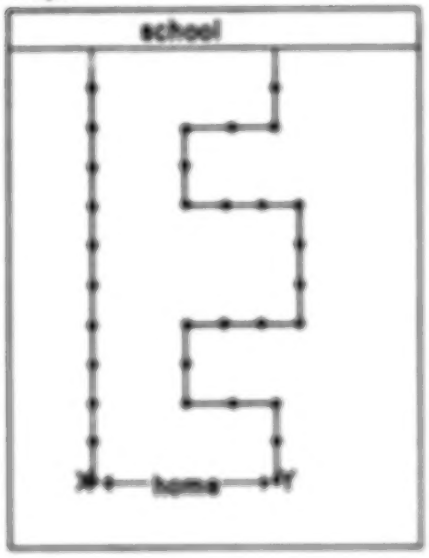
The first problem in the task began with both dolls standing parallel to each other at the beginning of their own paths The question for the child was whether one doll would actually get to school before the other or not. In this situation, a correct prediction was that the doll on the short path would reach the school-house first. In fact, the doll on the long path would only get half way there.

The next type of problem began where the first one ended and introduced a third doll that started from the beginning of the short path and went on her way to school. The question, then, was whether the doll who was half way along the long path would get to school before, at the same time, or after the doll who was just at the beginning of the short path. The correct prediction was that both of these dolls would get to school at the same time.

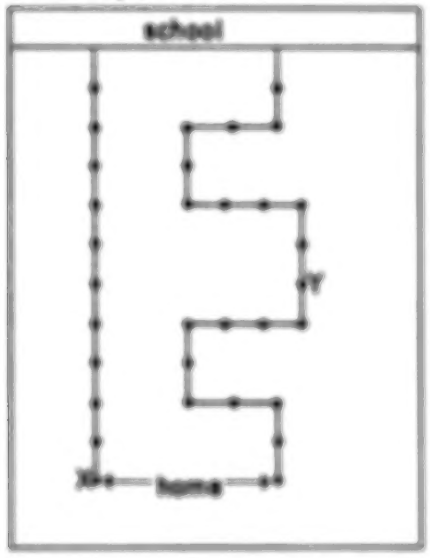
Figure 4-2

Diagrams of the Four Types of Problems

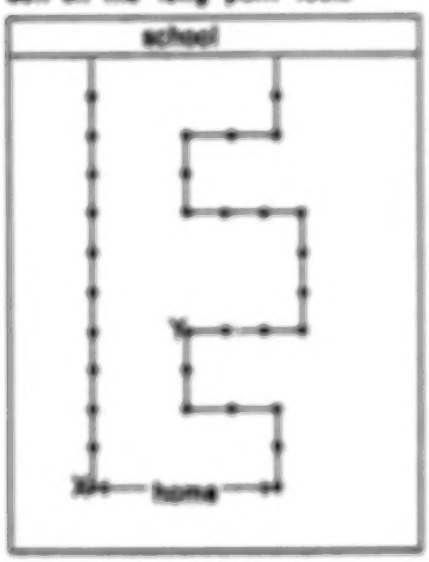
Type 1 Problem--
Some starting places, some size steps.



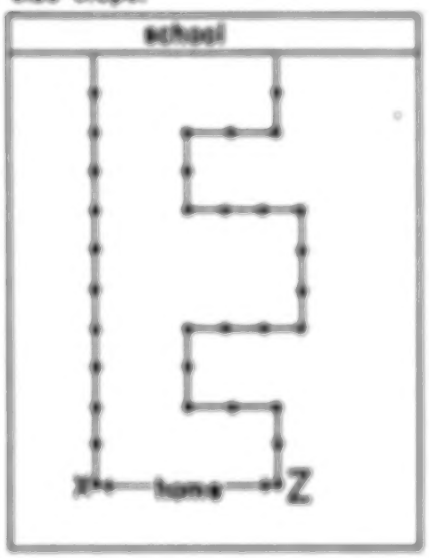
Type 2 Problem--
Different starting places, some size steps.



Type 3 Problem--
Doll on the short path must take a walk as long as the one the doll on the long path took.



Type 4 Problem--
Some starting places, different size steps.



In the third type of problem, through which nonverbal understanding of distance was assessed, the child was asked to have his doll take a walk just as long as the one he saw the examiner's doll take. The walk taken by the examiner's doll was in both parallel and perpendicular directions to the subject's path because the former was crooked and the latter straight. If the child moved his doll to a position parallel to the examiner's doll, he would have taken his doll on a walk of lesser total distance than the examiner's doll took. The correct performance would have been to move the doll an equal number of units on the straight path which meant that the subject's doll should have been ahead of the examiner's doll, not parallel to it.

If the child grasped the idea of counting the number of holes to solve these previous distance problems, he was then presented with the last type of situation. This used one of the dolls from the previous problems and one "big doll" who could walk two steps at a time The situation was presented with the small doll at the beginning of the short path and the big doll at the beginning of the long path. The child was shown how the big doll could take big steps. The problem for the child was to realize that taking two steps at a time along a path twice as long as another would have the same outcome as taking one step at a time along this other path.

Results and Discussion

The results showed that predictions of problem 1 were by far the easiest of the predictions for all subjects, 71% of the 248 children answered this problem correctly. This high percentage of correct predictions for the combined presentations of this problem contrasts with the much lower percentage correct for the three remaining types of problems as seen in Table 4-1

Table 4-1

Percentages of Correct Predictions for All Presentations of Each Type of Problem

(N=248)

Problem 1	71
Problem 2	4
Problem 3	20
Problem 4	7

Table 4-2

Percentages of Correct Predictions for Problem 1

	Low SES		White SES	
	Pre-K (N=48)	K (N=60)	Pre-K (N=48)	K (N=61)
Presentation I				
Prediction: Do you think one will get to school before the other?	71	72	79	60
Presentation II				
Prediction: Which doll has a longer way to go?	33	51	85	87
Prediction: Which one will be more tired when she gets to school?	44	67	85	82
Prediction: Which one will get there first?	63	80	88	95

In problem 1, it was apparently easy for the subjects to notice a difference in the length of the two paths when the dolls were placed in positions parallel to each other at the beginning of the paths. In the second presentation of this problem, the wording of the prediction question was changed to determine the effects of presumably more meaningful language on the accuracy of the prediction. Three different questions were substituted. These were: (1) "Which doll has a longer way to go?" (2) "Which one will be more tired when she gets to school?" (3) "Which one will get there first?" The percentage of the subjects correct in the first as compared to the second presentation of the situation is shown in Table 4-2. These results show that both the nursery school and the kindergarten children of the middle class group had a higher percentage correct when the rephrased questions were asked. This was an increase for the middle class four-year-olds from 79% correct to 86% correct, and for the five-year-olds from 60% correct to 88% correct. For the middle class group as a whole, there was then an increase from about 70% correct to 87% correct, which was statistically significant ($p < .05$). It is, however, difficult to know how much of the increase was due to experience with a similar problem earlier in the task and how much to a change in the language of the questions. It is also not clear why the five-year-old middle class children had a smaller percentage correct than the other groups in the initial prediction for this problem.

On the other hand, the lower class group significantly decreased in the percentage correct when the rephrased language was used. The lower class four-year-olds decreased from 71% correct to 46% correct, and the five-year-olds decreased from 72% to 66% correct. This decrease in correct predictions for the lower class group <u>as a whole</u> from presentation 1 to presentation 2 was 71% to 56%.

The prekindergarten children in the lower class sample decreased noticeably more than those in the kindergarten despite the fact that they had both had essentially the same percentage correct when the problem was first presented. The surprising conclusion from those findings was that the so-called simpler or more meaningful way of presenting or rephrasing questions for children had quite different effects depending on the social class of the child. Middle class children's understanding was facilitated while lower class children's comprehension was debilitated.

Problem 2 showed approximately 4% correct predictions for all subjects. The additional difficulty of solving the distance problems when the two dolls start at different points along their paths was apparent in the small number of correct responses for this situation. A second presentation of this problem showed only a 1% increase from the first presentation. This was the only situation that did not show a significant increase in accuracy of prediction from the first to the second presentation for either social class and shows that this problem using unequal starting places was one of the most difficult of the four types of problems used in this task.

The third problem in which the subject had his doll take a walk as long as the walk taken by the examiner's doll proved initially to be very difficult with only 4% of the sample getting this correct. However, during the second presentation, 36% of the total sample accurately solved the problem. The largest differences among subcategories of the sample again seemed to be social class differences which can be seen in Table 4-3. For this situation, the subjects in each social class differed initially by only a small percentage, but on the second presentation, the middle social class had a much greater percentage correct than the lower social class.

Table 4-3

Percentages of Correct Predictions for Problem 3

	Low SES		Middle SES	
	Pre-K (N=48)	K (N=69)	Pre-K (N=48)	K (N=83)
Presentation 1				
E's doll moves 6 steps	0	4	6	7
Presentation 2				
E's doll moves 3 more steps	10	25	54	57

In the final problem which used a "big" doll that could walk two steps at a time and a smaller doll that could only walk one step at a time, the initial number of correct responses for the total sample was 1%. However, 70% of the lower class sample and 8% of the middle class children were not given either of the presentations of this problem because they had not demonstrated any use of counting to solve the previous problems. The percentages of correct predictions for the second presentation of this problem were 4% for the lower class children and 22% for the middle class children.

Comparisons of predictions and descriptions across the various situations showed that descriptions were easier for all the children, as could be expected. The middle class children did, however, tend to be more correct in their descriptions of what had just happened when the dolls were moved along their paths than the lower class children were.

It is important to note that on the prediction and performance items with which neither low nor middle class subjects had familiarity, the children of the two social classes did about equally well. However, the middle class children clearly showed a greater ability to profit from variations in language and to generalize from one presentation of a problem to another. Among the lower class children, the prekindergarten children had a noticeably smaller percentage correct than the kindergarten children for all the items. In the middle class sample, the younger group of children tended to have only a slightly smaller percentage correct than the older children. This was probably due to the similarity in vocabulary level between the two middle class age groups as shown on the picture vocabulary test.

The total score for each subject on this task was comprised of eight prediction items, five description items, and two performance or nonverbal items. Answers that were correct were given a value of 4, those that showed partial understanding of the situation were given a weight of 2, and those that were completely incorrect received a score of 0. Thus, the possible range on this task for each subject was 0-60. (The reasons given by the subjects throughout the task to explain their responses were not used to compute the total score because their qualitative character did not easily lend itself to a correct versus incorrect type of categorization.) Table 4-4 shows the means and standard deviations of the total scores by age and social class.

The results of an analysis of variance showed significant differences in age and social class but not sex. Each six-month age group of children had higher total scores than the group younger, and the middle social class had higher total scores than the lower social class. These results indicate that the task does discriminate between four- and five-year-olds and between lower and middle class children, at least for the subjects as a group.

The reasons given by the subjects to explain their answers throughout the task were assigned to eight categories that had been placed in an a priori order based on pretesting results. These reason categories are seen in Table 4-5. To determine if the a priori order of the reasons categories was reasonable in relationship to the total score on the task, the total score was determined for each of the reason categories. An analysis of variance showed that there was complete and significant agreement between the total score for the task and the order of the reasons, such that the total score of the subjects who answered at response level 8 was higher than the total score of the subjects who answered at

Table 4-4

Means and Standard Deviations of the Total Score

on the Time Distance Task

Low SES				Middle SES			
Pre-K (N=48)		K (N=69)		Pre-K (N=48)		K (N=83)	
$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
34.2	7.55	38.74	6.78	45.41	4.22	47.13	3.37

level 7, and so on. These results showed that the reasons given by the children are additional indicators which could be used in the assessment of their understanding of distance and movement concepts. The correlation between level of reasons given and age, r = .25, was also significant.

The correlation between the Total Score on the Distance task and the Peabody Picture Vocabulary Test raw score was .55 with an N of 170. It is probable that the relationship between the two variables is largely due to the fact that part of what both are measuring is the child's comprehension of the spoken word.

This measure of children's understanding of distance, movement, time, and number concepts has been presented to describe in some detail the nature and extent of preschool children's ability to coordinate more than one dimension at a time in solving problems of distance. The concepts involved in making these judgments appear to be aspects of cognitive functioning useful in decisions necessary for everyday living.

Table 4-5

Categories of Reasons Given by Subjects to Explain Predictions

---

1. Responses which the coder cannot understand well enough to classify or cannot tell what category the response should be placed in.

2. Responses indicating the child doesn't know what to say as well as those left blank on the sheet. Examples:

I don't know.
Can't say.
I forgot.

3. Responses which are unrelated or just made up. Examples:

He (SP)[a] went more cause he (LP)[b] was tired.
Because it's brown.
Because of the tree.
Because she's a girl.
He looks good to me.

4. Responses pertaining to the doll's or child's rate of movement or their starting time. Examples:

I went fast.
You didn't go faster.
We both went fast.
I wanted to get to school faster to see my teacher.
He has to hurry up to his class.

5. Responses explaining why the LP doll will get to the destination first.

(Pertains only to problem 2 with different starting points for dolls.)

Examples:

The house is further.
She's (LP) a little in front of him.
Because this (SP) is a long line or the (LP) has a shorter road.

Table 4-5 (continued)

6. Responses pertaining to the length of paths or to the distance to be traveled by the doll. Examples:

That one (SP) is shorter.
It's (LP) longer.
She (LP) is going a longer way.
'Cause when it's crooked, you have a hard time; when it's straight you don't.
Mine (SP) isn't zigzag; yours (LP) has more holes.

7. Responses pertaining to larger size steps the big doll can take. (Pertains only to situation 4 in which one doll moves two steps at a time.) Examples.

He (LP) takes 2 steps at a time.
Takes giant steps (big steps).
Because he skips one.

8. Responses indicating that the child knows what happened in the situation that was presented just before. (Pertains only to problem 4 where the two presentations of the situation were consecutive.) Examples:

Because they went before the same way.
It happened before.
Before they got there at the same time.

[a]SP refers to the doll on the straight or short path.

[b]LP refers to the doll on the crooked or long path.

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Piaget, J., Inhelder, B., & Szeminska, A. The child's conception of geometry. London: Routledge and Kegan Paul, 1960.

5. A STUDY OF NUMBER CONSERVATION IN YOUNG CHILDREN, UNDER TWO MATERIALS CONDITIONS

Lewis W. Pike

The purpose of this study was to assess the ability of four- and five-year-old children to compare the number of objects in two sets, regardless of the spacing of these objects. The difficulty in judging the numerical equivalence of sets under several different rearrangements was determined for subjects grouped by age and socioeconomic status. The judgmental tasks were given under two materials conditions, one designed to facilitate conserving The effect of giving an item with one material after having already given it with the other material was also examined.

Basic Piagetian Task

The task used was derived from one of Piaget's eight basic number experiments and involved one-one correspondence of equivalent sets of objects (Piaget, 1965). The experiment providing the model for the present study may be described as follows

> A set of objects is placed before the child. Then, an equivalent parallel row is constructed, giving the configuration shown in Figure 5-1a. Note that in this arrangement, each element of set A is visually linked with the corresponding element of B. The child is then asked whether there are as many objects in B as in A. Next, the visual cue to the one-one correspondence of elements is destroyed by either compressing or expanding one of the rows, giving something like you see in 5-1b The child is again questioned on the numerical equivalence of the sets

Figure 5-1

Configuration for Basic Number Conservation Task

a. Equivalent rows; visual correspondence	b. Equivalent rows; no visual correspondence
A: x x x x x	A: x x x x x
B: x x x x x	B: x x x x x

This task has the advantage of being one of the easiest of the eight (Elkind, 1961; Hood, 1962) Further, there is an interesting added dimension for this task, namely either using objects that are homogeneous across both sets, or objects that are homogeneous within sets, but with objects in set A functionally related to those in set B In the former, recognition of one-one correspondence must be "spontaneous"--i e , not prompted by characteristics of the materials. In the latter, where the sets of objects are qualitatively complementary, the one-one correspondence of elements is ". . as it were, provoked by external circumstances" (Piaget, 1965, p. 42) Studies conducted by Hood (1962) and Dodwell (1960) support Piaget s assertion that the "provoked correspondence" variant is much easier than the "spontaneous correspondence" one.

Procedure

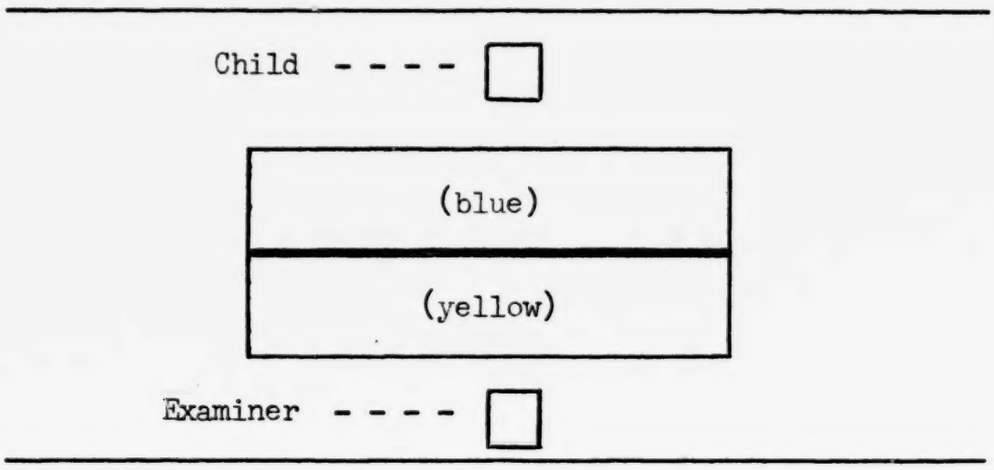
While retaining the essentials of the Piagetian task just described, the number conservation task developed for the present study has several modifications.

A special board, shown schematically in Figure 5-2, was designed for administering the task It was always placed with the yellow side toward the interviewer and the blue side toward the child The terms "blue side" and "yellow side" were used in referring to sets of objects, rather than "your side" and "my side." Instruction was given for the terms "blue side," "yellow side," "bunch," and "same number."

As in most American and English replications of Piaget s experiments (Hood s 1962 study is an exception), a standardized form of inquiry was used. After the equivalence of the sets had been established, the examiner altered one or both rows. Following this, she first asked if the two bunches had the same number of

Figure 5-2

Seating of Child and Examiner with Special Board Used for Administering the Task



objects, and then whether one bunch had more. This procedure avoided the bias introduced by asking either question alone, or the problems resulting from asking both questions in a single, long question. In particular, assigning conserving status to responses based on "yes-saying" or on repeating the experimenter's last statement was avoided. If the child judged the sets to be equivalent, he was asked, "How can you tell?". If he judged the sets to be nonequivalent, he was asked, "Which bunch has more?" and "How can you tell?", and was then requested to "Change the blue side so it has the same number of blocks (toys) as the yellow side." The procedure for administering a typical item in this study is shown in Figure 5-3.

Another task modification was that several variations were used in altering one or both sets after their initial equivalence had been established. This was done to provide a fairly broad basis for assessing conservation status, while using a single, comparatively simple conservation task. The variations are listed and the changes indicated in Figure 5-4. Each will be considered in turn.

Equal subtraction. This item was used primarily as a "warm up" to subsequent conservation items.

Lateral displacement. After establishing the equivalence of the two bunches, the examiner shifted each of the "yellow side" elements a unit length to the right. Note that length and density were not altered by this change.

Row collapsing. The yellow-side row was compressed, as indicated, giving a length versus density contract.

Re-subgrouping. Re-subgrouping resulted in a length-density contrast, but the density aspect was much more pronounced than it had been in earlier items.

Figure 5-3

Sample of Instructions for Administering a Typical Item of the Conservation Task

Row Collapsing

Set up the formation: Ch: x x x x x (blue side)
E: x x x x x (yellow side)

E: THIS BUNCH (on blue) HAS THE SAME NUMBER OF BLOCKS AS THIS BUNCH (on yellow). NOW WATCH WHAT I DO THIS TIME.

Collapse the E-row, producing: Ch: x x x x x
E: x x x x x

E: 1. DOES THIS BUNCH (on blue) HAVE THE SAME NUMBER OF BLOCKS AS THIS BUNCH (on yellow)? Whether yes or no, go on:

2. DOES ONE BUNCH HAVE MORE BLOCKS?
If yes: a. WHICH BUNCH?
b. HOW CAN YOU TELL?
c. CHANGE THE BLUE SIDE SO IT HAS THE SAME NUMBER OF BLOCKS AS THE YELLOW SIDE.

If 1 is no and 2 is no: Ask question 1 again. If yes, go on to 8.

If no, say:

a. WHICH BUNCH HAS MORE BLOCKS?
b. HOW CAN YOU TELL?
c. CHANGE THE BLUE SIDE SO IT HAS THE SAME NUMBER OF BLOCKS AS THE YELLOW SIDE.

If 1 is yes and 2 is no: HOW CAN YOU TELL?

Figure 5-4

Configurations and Materials Used in Number Conservation Tasks,

for Forms A and B

Item Type	Configuration after one or both sets were altered by examiner	Form A		Form B	
		Blocks	Toys	Toys	Blocks
Color, "Bunch," and "Same" Instruction		Item 1 " 2 " 4		Item 1 " 2 " 4	
Equal Subtraction	Ch: x x x x E: x x x x	" 5		" 5	
Lateral Displacement	Ch: x x x x x E: x x x x x	" 6		" 6	
Row Collapsing	Ch: x x x x x E: x x x x x	" 7		" 7	
Re-Subgrouping	Ch: x x x x x E: x x x x x	" 8	Item 12	" 8	Item 12
Equal Addition	Ch: x x x x (added) E: x x x x	" 9	" 13	" 9	" 13
Unequal Addition	Ch: x x x x x (added) E: x x x x	" 10	" 11	" 10	" 14

Equal addition The equivalence of two sets of three elements was first established. Then the examiner added one element within the "yellow side" row, and another extending the "blue side" row. This produced a length-density contrast, but by a different kind of change than in the previous items.

Unequal addition Here, two elements were added within the three-element row on the yellow side, and one was added extending the row on the blue side. On this item, nonequivalence, rather than equivalence, had to be recognized

A particularly basic modification was presentation of the items under two materials conditions, as illustrated in Figure 5-5. In one of the conditions all elements of both sets were the same In the other, the objects within each set were heterogeneous, but for each object in one set there was a matching object in the other This is illustrated in Figure 5-6. The first materials condition paralleled Piaget's "spontaneous correspondence " The second was a form of "one-one provoked correspondence," but was substantially different from that introduced by Piaget It was suggested, in part, by Zimiles' (1966) description of a stimulus condition in which all elements across both sets were heterogeneous. In the "provoked correspondence" condition used by Piaget, the elements were homogeneous within each set, but the elements of one set were functionally related to those of the other In some experiments, for example, vases constituted one set, and flowers the other In the "one-one provoked correspondence" condition developed for the present experiment, the relationship was that of identity rather than function. It drew attention to the unique one-one correspondence of each pair. Differences associated with the two materials conditions turned out to be of particular importance in this study

In order to compare the effect of materials condition on conserving, alternate forms of the overall task were constructed, differing only in the

Figure 5-5

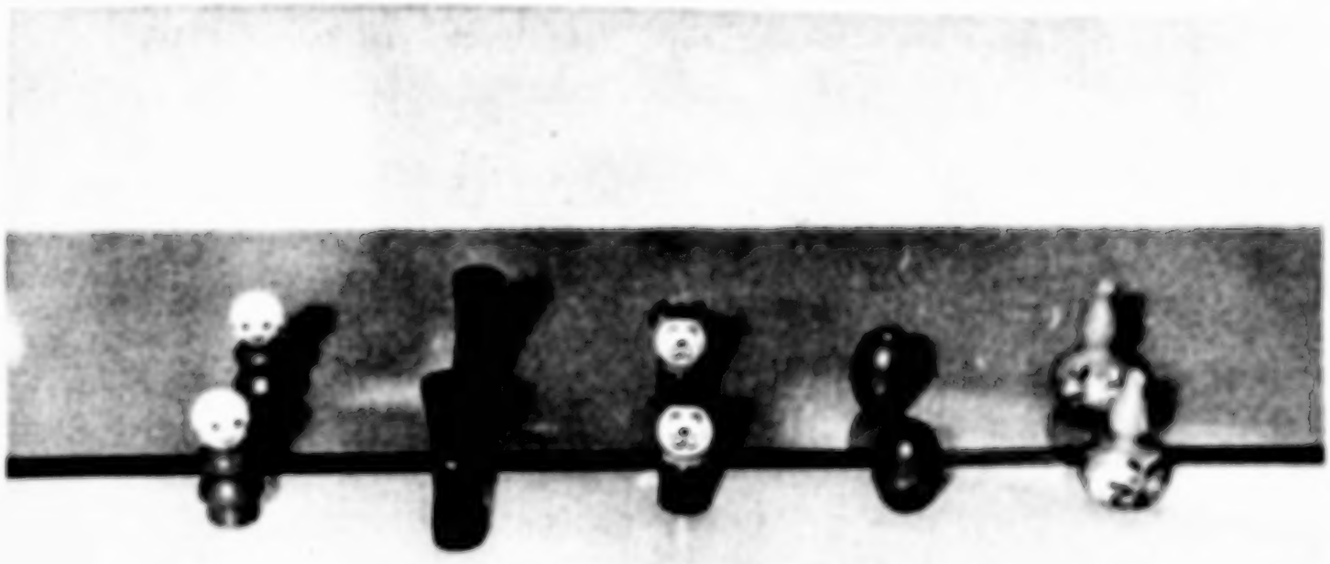
The Two Materials Conditions for the Unequal Addition Problem

1. Homogeneous throughout	2. Identical pairs*
Ch (Bl): x x x x x E (Yel): x x x x	Ch: Wo Tr Va BB Bo E: Wo Va Bo BB

* Toys indicated are: Woman, Tree, Vase, Boot, and Baby Bottle.

Figure 5-6

Standard Initial Array of Toys for Number Conservation Task



material used for each item, as indicated in Figure 5-5. In Form A, blocks were used first, then on the repeated items, toys were used. This order was reversed in Form B. Subjects were divided into groups A and B, matched on SES, age, and sex: Form A or B was given to each child, according to this grouping. One hundred and eleven children were given Form A, and 103 were given Form B. A breakdown of these N s is given in the tables of data.

For the conservation of equality items, the conserving response pattern to the questions "same number?" and "one bunch more?" was "yes," then "no." The correct response pattern to the conservation of inequality questions "same?" and "more?" was "no, yes." Further, the subject had to indicate correctly which row had more objects, before his response could be counted as conserving. Responses to "How can you tell?" and "Change the blue side so it has the same number of blocks (toys) as the yellow side" were scored and recorded but will not be reported in this paper.

Results

We will first examine differences associated with item type and material. Data for these differences are given in Tables 5-1 and 5-2. For both materials conditions, the conservation of inequality item, item 10, was substantially easier than any of the four conservation of equality items. Even the low SES children showed age-related gains on item 10, although they showed essentially no improvement with age on the conservation of equality items.

Differences in difficulty among the conservation of equality item-types were moderate, but there was an interesting reversal in comparative

Table 5-1

Percentages of Conserving Responses on Items A5-A10 (Blocks)

Item	Type	Low SES Pre-K (N=22)	Low SES K (N=25)	Middle SES Pre-K (N=19)	Middle SES K (N=45)	All Subjects (N=111)
A5	Eq. Subtr.	14	44	79	82	59
A6	Lat. Displ.	9	8	16	27	17
A7	Collapsing	5	4	21	31	18
A8	Re-Subgr.	5	4	16	24	14
A9	Eq. Add.	5	0	16	22	13
A10	Uneq. Add.	14	20	37	36	28

Table 5-2

Percentages of Conserving Responses on Items B5-B10 (Toys)

Item	Type	Low SES Pre-K (N=19)	Low SES K (N=26)	Middle SES Pre-K (N=20)	Middle SES K (N=36)	All Subjects (N=103)
B5	Eq. Subtr.	21	39	70	77	55
B6	Lat. Displ.	5	4	25	17	13
B7	Collapsing	5	7	35	19	16
B8	Re-Subgr.	11	7	30	14	14
B9	Eq. Add.	11	14	45	22	22
B10	Uneq. Add.	5	21	55	42	32

difficulty, associated with the materials condition. Under the blocks condition, the Lateral Displacement item, A6, was easier than the Equal Addition item, A9. Under the toys condition, however, the Lateral Displacement item was harder than the Equal Addition item. A possible reason for this reversal is illustrated in Figure 5-7. When blocks were used, item 6 was easier than 9, presumably because the rows in 6 were of equal length. When toys were used, subjects may have tended to check each element of one set against the matching element of the other. For item 6, this would have been difficult, since none of the identical pairs were opposite one another to provide strong visual cues to one-one correspondence. For item 9, however, elements of 3 of the 4 pairs of identical elements were placed opposite one another.

The usefulness of having several conservation of equality item types is indicated in Figures 5-8a and 5-8b, which show the percentage of children conserving on one or more, two or more, three or more, or all four items. If children's conserving status were all-or-none, and if they responded consistently according to whether or not they were conservers, the slopes would have been zero. In that case, using more than one or two items would have added no information regarding the children's ability to conserve.

Consider next the differences associated with material for the two groups of conservation of equality items, A6 to A9 and B6 to B9, as shown in Figure 5-9. You will recall that for the item group A6-A9, homogeneous sets of blocks were used as stimulus material, and that for items B6-B9, toys that were heterogeneous within sets, but matched across sets, were used. It may be seen in Figure 5-9 that middle SES children conserved much more often under the blocks condition

Figure 5-7

Arrays of Toys for Items 6 and 9

Item 6. Lateral Displacement						Item 9. Equal Addition				
Bd	Va	Wo	Bo	Dg		Wo		Va	BB	Bo
	Bd	Va	Wo	Bo	Dg	Wo		Va		Bo	BB

Figure 5-8a

Percentages of children conserving on 1 or more, 2 or more, 3 or more or all four items, in the conservation of equality set 6A-9A (Blocks)

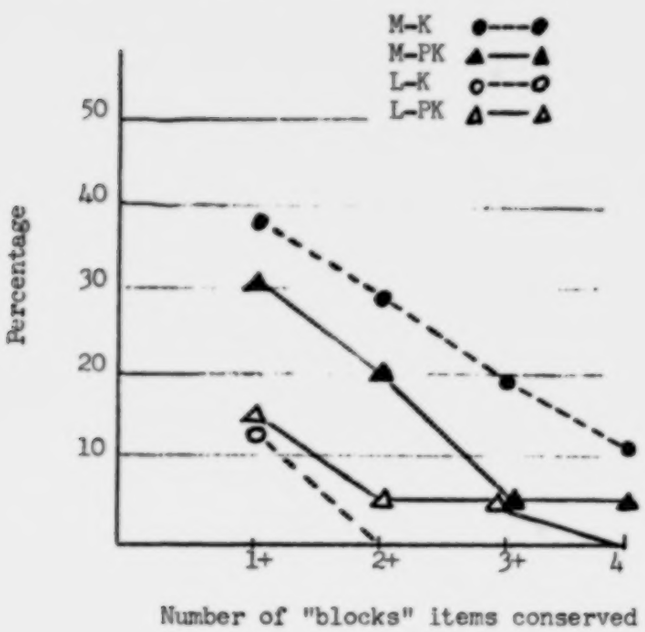
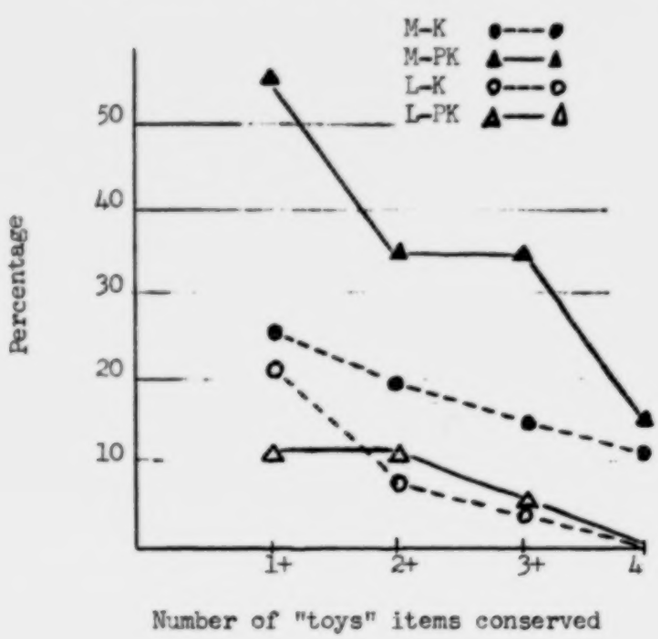


Figure 5-8b

Percentages of children conserving on 1 or more, 2 or more, 3 or more, or all four items in the conservation of equality set 6B-9B (toys)



than did low SES children. Among low SES children, there was no gain as a function of age, but there was such a gain among middle SES children.

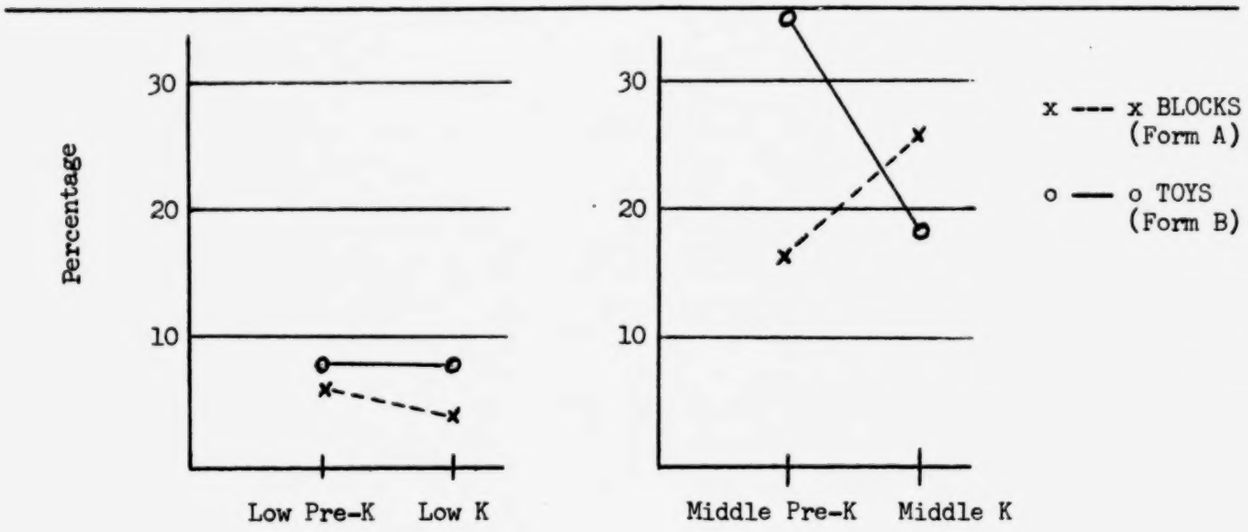
In the items of Form B, one-one correspondence was presumably "provoked" or prompted by the identity relationships holding between unique elements in the blue side row and matching unique elements in the yellow side row. For the toys items, as for the blocks items, there was a marked SES difference favoring the middle SES children. Again, no gain in percentage of conserving responses was associated with age of low SES children. Among the middle SES subjects there was a marked age effect, but to our surprise, a loss, rather than gain in conserving score, was associated with increasing age. As the crossed lines on the graph indicate, there was a pronounced age by materials interaction for middle SES children. Among the middle SES subjects, the younger children performed much better under the toys condition, but the older children performed better with blocks. How can the age by materials interaction be explained? It may be that many of the middle SES kindergarteners were beginning to conserve on an abstract basis. For them, the toys condition may have induced confusion between two judgmental modes, with a resultant decrease in ability to conserve on the materials at hand.

We will next consider order effects. On each form of the test, two of the conservation of equality items and the conservation of inequality item were repeated, but with a change of material. As shown in Figure 5-10, the differences by order for low SES prekindergarten children were very small. Among the remaining three groups, however, there were sizeable order differences on each item. For the low SES kindergarten and middle SES prekindergarten groups, there was a higher percentage of conserving responses when the blocks variant of the item

Figure 5-9

Percentages of Conserving Responses, Averaged Over Items 6-9,

Conservation of Equality[a]

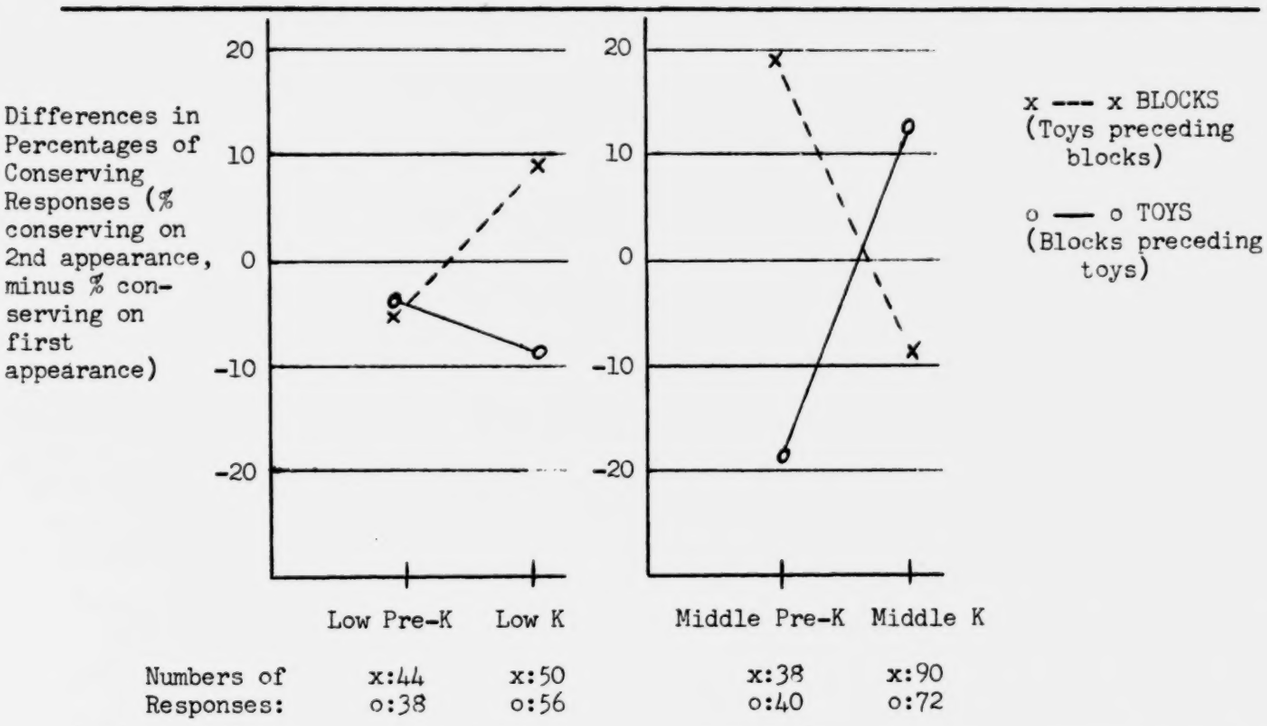


[a]These data are based on four responses per child.

Figure 5-10

Order Effects for the Repeated Conservation of Equality Items[a]

(Re-subgrouping and Equal Addition)



[a]These data are based on two responses per child.

type came second rather than first. For middle SES kindergarteners, the effect was in the opposite direction. Their ability to conserve on a given item-type under the blocks condition was reduced, rather than increased, when the item-type had already been given under the toys condition. Results for the Toys version of the conservation of equality items are also shown graphically in Figure 5-10. Again, differences due to order for low SES prekindergarteners were small. For low SES kindergarteners, and middle SES prekindergarteners, there was a lower percentage of conserving responses on the Toys version of the item when it followed the Blocks version than when it came first. That is, prior experience with the Blocks version of an item interfered with, rather than aided, the ability to conserve on that item in its Toys format. Conversely, middle SES kindergarteners performed better on these Toys items when they followed the Blocks versions than when they did not.

These order effects may be summarized and restated as follows:

1. Low SES, Pre-K: There was little if any order effect.
2. Low SES K, and Middle SES Pre-K: Previous exposure to a Toys version of an item type facilitated conserving on the Blocks version, but previous exposure to a Blocks version interfered with conserving on the Toys version.
3. Middle SES K: Previous exposure to a Toys version of an item type hindered conserving on the Blocks version, but previous exposure to a Blocks version facilitated conserving on the Toys version.

Recalling that on first exposure, toys were easier for the low SES kindergarten and middle SES prekindergarten groups, and blocks easier for the middle SES kindergarten group, the apparently contradictory order effects can be described by the following generalization:

For a given group of subjects, if an item given with one material was preceded by an item of the same type with an easier material, conservation was facilitated. If it was preceded by an item of the same type with a more difficult material, conservation was hampered.

Summary

Middle SES children consistently performed better than low SES subjects on the number conservation tasks used in this study. There were essentially no age effects among low SES children, but there was a materials effect. The toys condition, with the matched-pairs cues providing "one-one provoked correspondence," was easier for both low SES prekindergarteners and kindergarteners. Among middle SES children, there was an age by materials interaction. Middle SES prekindergarteners performed better under the toys condition than under the blocks (spontaneous correspondence) condition, but the reverse was true for middle SES kindergarteners.

The conservation of inequality item was easier than the conservation of equality items. Differences in difficulty among conservation of equality items interacted with the materials conditions.

The order in which alternate materials for an item type appeared yielded the following effect. When an item type was repeated, but with a materials change, subjects tended to repeat their earlier response pattern. Thus they tended to do comparatively well if the item was presented first in its easier format, and comparatively poorly if it was presented first in its more difficult format.

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6. CHILDREN'S UNDERSTANDING OF BASIC LANGUAGE STRUCTURE

Anne M. Bussis

Introduction

Pretend for a moment that you are quite small, about three years old, and attending your first performance of Hamlet. Enter Hamlet in Act III and you might well hear ...

"To be ... ... to be: That is the question."

Perhaps nowhere in English literature is the importance of syntactic structure better illustrated than in the opening line of this famous soliloquy. If one doesn't understand the conjunction "or" and the adverb expressing negation, the noble Prince of Denmark is reduced to a meaningless stammer.

When do children begin to comprehend the small words and inflections that govern syntactic structure and logical meaning? Is the child from a restricted language environment retarded in his development of such comprehension, as Bernstein (1961) and Bereiter and Engelmann (1966) suggest? Or, is even a minimal language environment sufficient stimulation for a child to develop the grammatical rules of adult language, as many linguists (e.g., Weksel, 1965; Lenneberg, 1967) would suggest? These are some of the issues and questions we wished to explore in our study of New York City children.

The measures used to explore these questions were the Language Comprehension Task (LCT) and the Verbal Instructions Task (VIT). Although both tasks measure the child's language comprehension (as opposed to production), they differ in one important respect--response mode. In the LCT (a measure utilizing Roger Brown's "Matched Pictures" technique), there are 20 cards containing pairs of

stimulus pictures, as illustrated in Figure 6-1. Both pictures in a pair contain identical elements, but they depict different relationships between the elements. The child's job is to distinguish which relationship a particular word implies and point to that picture. For example, the child is shown a pair of pictures and told that they are named "Bear is sitting" and "Bear is not sitting"--without indicating which picture is which. He is then asked to point to the picture called "Bear is not sitting."

The VIT is a task adapted from Betty Caldwell's Preschool Inventory which requires the child to indicate his understanding by manipulating various materials. These are pictured in Figure 6-2. To test understanding of the word "between," for example, the child is asked to place a toy ladder between two boxes. To test understanding of negation, he is given such instructions as: "Hand me a car, but not this one"--the examiner pointing to one of two toy cars. Only materials pertinent to each question were placed in front of the child, the others being kept out of sight or reach so as not to distract him.

Both measures included training items to insure that the children understood the response procedure of either pointing or manipulating objects. Items were scored right or wrong; and analyses were made of total scores, subtest scores, and individual items. Since individual item analyses were the most interesting, these are the data discussed here. Mean scores are presented in the Appendix to this paper, however, for those who wish to inspect them.

Results on the Verbal Instructions Task (VIT)

Table 6-1 shows percentage of correct responses on the Negation and Conjunction items respectively. On these particular subtests, there are few

Figure 6-1

Sample items from the Language Comprehension Task

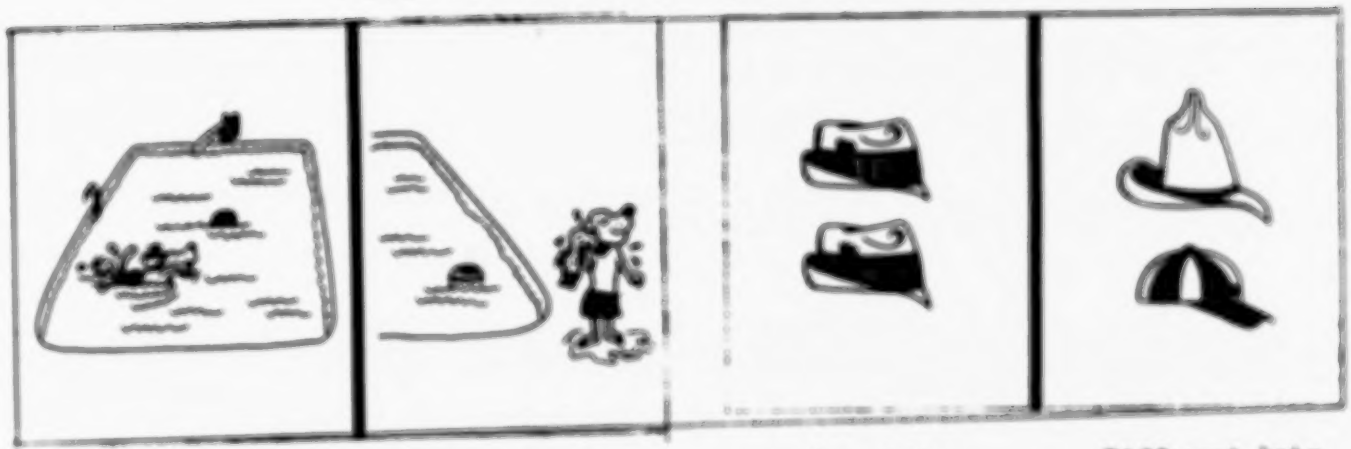

Figure 6-2

Materials Used in the Verbal Instructions Task

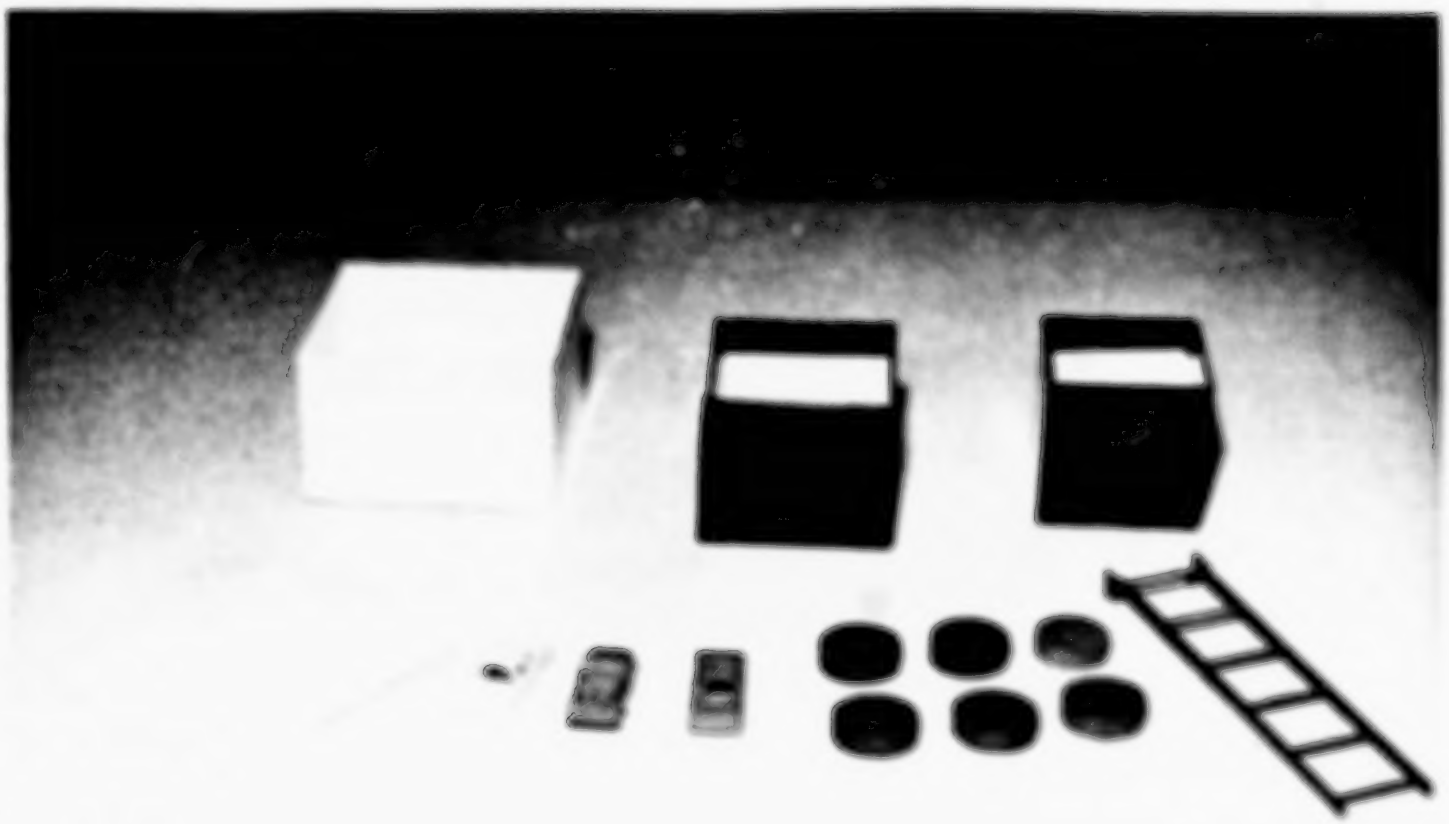

Table 6-1

Percent Correct Responses on Negation and Conjunction Items of the Verbal Instructions Task

Item Number and Items	Low SES		Middle SES	
	Pre-K (N=42)	K (N=49)	Pre-K (N=39)	K (N=63)
Negation				
8. Point to the box without the ladder	52	73	87	90
11. Hand me a car but not this one	93	98	95	97
15. Put a car in a box but not this one	93	96	100	98
18. Do not put a checker in this box but in this one	88	94	97	100
Conjunctions				
9. Hand me a car and a checker	98	94	100	100
10. Hand me a car or a checker	86	82	97	95
14. Put a car in this box or in this box	83	90	82	98

differences between children of different ages and social class. All of the groups respond with a high degree of competence. The only obvious difficulty our lower class children had was in comprehending the implied negation of the word "without"; and here, the older children performed significantly better. Unlike Carl Bereiter's findings, our children showed good understanding of "or" and "not," at least on these particular items. (Perhaps we might take them to see Hamlet after all.)

Turning to Table 6-2, we find a similar result in the opposite direction--that is, virtually no differences between children, but all of them responding at a very low level of comprehension. This deserves some explanation, since the children obviously did well on the word "smallest," apparently indicating understanding of the superlative ending est In fact, however, item #25 was the only one they could have gotten correct by simply paying attention to the stem word and ignoring its inflection The procedure for testing adjective inflections was admittedly tricky but defensible, I think, as a measure of genuine comprehension of word endings. The child was presented with three boxes of differing size and was told:

> Now we have three boxes I am going to call them Big Box, Bigger Box, and Biggest Box. Hand me the Bigger Box

The overwhelming response here was to ignore the "er" ending and to hand the examiner the largest, white box The stem word "big" was apparently all these children comprehended and it had but one, absolute value. For the next item (#25), the examiner turned the boxes over, switched their position and said:

> Now I am going to call them something else. I am going to call them Small Box, Smaller Box, and Smallest Box. Hand me the Smallest Box.

Table 6-2

Percent Correct Responses on Comparative Adjective Items of the Verbal Instructions Task

Item Number and Items	Low SES		Middle SES	
	Pre-K (N=42)	K (N=49)	Pre-K (N=39)	K (N=63)
24. Bigger box	10	6	26	13
25. Smallest box	79	76	85	89
26. Big box	2	4	5	6

As can be seen, most of the children made the correct response. But they could have done so by attending only to the stem word "small" and again attaching an absolute value to it. To test this hypothesis, we added a final question (#26) in which the examiner turned the boxes over once again and told the child she was now going to call them by their original names: Big Box, Bigger Box, and Biggest Box. She then asked the child to hand her the Big Box. Total disaster followed, as in this case "Big Box" was actually the smallest box. Only nine of 193 children answered the question correctly. Apparently, the children in our study simply did not grasp the relative meaning of adjectives that is implied by their comparative and superlative forms.

Table 6-3 reveals a picture of somewhat greater competency in dealing with comparative adjectives. Here we were testing comprehension of the all-important more/less concept. These, of course, are irregular (or strong) adjectives which form the comparative by a separate word rather than an er ending. With the exception of the lower class preschool children there is a striking similarity of pattern between groups, but the middle class children perform significantly better than our lower class children on three of the four items ($p < .01$ for both "more" items, and $p < .05$ for the "less" item). This difference is most obvious on item #20 in which the children were asked to put more checkers in one box than another. On item #22, they were asked to put more cars in one box. There were six checkers and three cars. Since any random division of an odd number of objects results in one pile that has more, the "cars" item was not a clear-cut test. A more definitive indication of the child's understanding of "more" is obtained from item #20

Irrespective of differences in level of performance, the pattern of response indicates that "more" is a much easier concept for all children of

Table 6-3

Percent Correct Responses on Strong Comparative Adjective Items of the Verbal Instructions Task

Item Number and Items	Low SES		Middle SES	
	Pre-K (N=42)	K (N=49)	Pre-K (N=39)	K (N=63)
20. Put more checkers in this box	33	63	85	90
21. Hand me the box with less checkers.	38	18	49	38
22. Put more cars in this box	64	73	90	87
23. Hand me the box with fewer cars	19	14	26	22

this age than is either "less" or "fewer." Interestingly enough, however, the children did not appear confused by these items. When asked to surrender the box with less checkers, most of the children quite confidently handed over the box containing more checkers. The substitution of a concept they did know ("more") for one they did not know ("less") appeared to be a systematic and orderly strategy.

Finally, Tables 6-4 and 6-5 reveal the major sources of variance between our social class groups--plural/singular indices and prepositions. Bereiter's findings are clearly confirmed here, as our lower class preschool youngsters fall far below their more advantaged peers in understanding. While there are some significant improvements with age (on items 3 and 19), the general level of comprehension of plurals and all but the most common prepositions leaves something for the educator to ponder. It is interesting to note in Table 6-4 that the plural deficit of lower class children extends not only to various plural endings (a finding sometimes "explained" as a matter of dialect) but also to a distinct adjective denoting plurality--"each." It would seem difficult to interpret this finding purely in terms of dialectic idiosyncrasy.

Results on the Language Comprehension Task (LCT)

Table 6-6 shows percentage of correct responses on each LCT item. Interpretation of this task is somewhat muddied because of the large chance element that enters into the response. Since a child must point to one of two pictures, he obviously has a 50% chance of being right. Thus, a chance range of response was calculated, and is indicated at the bottom of the table. Actual interpretation of "chance" behavior, however, must be made with extreme caution.

Table 6-4

Percent Correct Responses on Plural-Singular Items

of the Verbal Instructions Task

Item Number and Items	Low SES		Middle SES	
	Pre-K (N=42)	K (N=49)	Pre-K (N=39)	K (N=63)
Plural-Singular Indices				
12. Put cars in a box	36	55	90	92
13. Put a car in a box	83	76	74	89
16. Put a checker in either box	81	86	82	94
17. Put a checker in each box	43	53	87	84
19. Hand me the boxes	52	82	100	95

Table 6-5

Percent Correct Responses on Preposition Items

of the Verbal Instructions Task

Item Number and Items	Low SES		Middle SES	
	Pre-K (N=42)	K (N=49)	Pre-K (N=39)	K (N=63)
1. Put the box on the card	98	100	100	100
2. Put the box under the card	57	76	92	87
3. Put a checker between the boxes	31	55	92	92
4. Put the ladder across the boxes	14	29	74	62
5. Put a checker in one box	86	86	97	100
6. Put the ladder in one box	83	86	100	97
7. Put a checker on one box	74	82	100	100

The first two LCT subtests (for Future and Past Tense) are most interesting and illustrate this need for caution. In each of these items, a present progressive picture title was paired with either a future or past tense title (e.g., "Cat is drinking" and "Cat will drink"; "The dog swam" and "The dog is swimming"; etc.) Half of the time the child was asked to point to the present tense picture and the other half to a future or past tense picture. The results clearly show that the progressive tense is under better control than other tenses, with virtually all the children understanding it. The future tense is somewhat harder and the past tense (particularly the irregular verb form "swam") is most difficult. This pattern holds true for all groups--though there are significant differences between middle and lower class children in their level of competency. What is more, there is no significant improvement between preschool and kindergarten among our lower class children.

What of the chance element here? As can be seen, all of the future and past tense items are responded to at a chance level by the lower class children, as is the irregular past tense by middle class children. For the most part, however, their behavior did not appear to be that of random guessing--they did not squirm, search the examiner's face for clues, switch back and forth between pictures, or otherwise appear undecided. The interpretation made here is again one of substituting a known quantity for an unknown one in a systematic fashion. They seem to assimilate, if you will, all tense inflections to the here-and-now progressive verb form.

Negation on this task (as on the VIT) is comprehended by practically all the children, while the before/after items (at the end of the list) are responded to by everyone at a chance level and in an apparently random fashion. Here, the

Table 6-6

Percent Correct Responses on the Language Comprehension Task Items[a]

Subtest and Items	Low SES		Middle SES	
	Pre-K (N=41)	K (N=49)	Pre-K (N=39)	K (N=63)
Future Tense				
Cat is drinking	95	90	95	98
Cup will fall	44	59	87	67
Mrs. Mouse is sweeping	90	98	100	95
Dog will eat	49	57	90	76
Past Tense				
Frog is jumping	95	90	100	89
Match burned	51	55	74	67
Dog swam	15	27	64	51
Cat is running	85	98	97	100
Negation				
Mr. Mouse is not reading	90	100	95	97
Bear is not sitting	90	98	100	100
More/Less				
More milk	95	94	97	100
Less candy	61	73	85	71
Less fish but bigger	88	86	90	81
More worms but shorter	56	67	87	86
Same/Different				
Same hats	51	76	92	94
Different size giraffes	73	69	95	92
Time Words (before/after)				
After	59	41	59	56
Before	46	43	62	60
After	51	51	64	60
Before	51	73	49	56
[a]Chance range of response:	34-66	36-64	34-66	37-63

(Based on the formula $\sigma = \sqrt{\frac{pq}{N}}$)

children did squirm, point back and forth between pictures, and so forth. These results, however, may be due to the greater ambiguity of pictures that were used for the last four items. Only these two subtests (negation and time words) produce equal performance by both SES groups. Lower class children lag significantly behind in their understanding of the same/different distinction, as they do in ability to handle at least one of the more/less concepts. Results on these particular items (more/less) are somewhat surprising and will be dealt with elsewhere in a discussion of the three-month longitudinal analysis.

Discussion

At least two things seem noteworthy about the overall results on the language tasks. First, there is a rather striking correspondence between our findings (at the purely receptive level) and other investigations that have studied the child's production and use of basic syntactic structures. Here, I am referring to Jean Berko's (1958) study in which she tested children's knowledge of word endings and to Paula Menyuk's (1964) study of syntactic rules used by children from preschool through first grade.

In the realm of specifics, Berko found only one child in her entire group of 80 who could supply the comparative and superlative endings to an adjective stem when given the appropriate cues. And her group consisted of 19 preschool and 61 first-grade children--all from middle class, mainly professional homes! We found our children at approximately the same stage in their comprehension skills. Another specific similarity is in the difficulty of verb endings. Berko found that most of her preschoolers could produce the progressive tense (ing) ending. Slightly harder was the "d" allomorph as in our past tense word,

"burned." The irregular past tense verb form did not exist at all in the speaking vocabularies of her preschool children and it existed for only 25% of her first-grade children. (The bell always "ringed"--it never "rang.") This, of course, is exactly the order of difficulty we found in the children's comprehension.

Perhaps more striking than specifics, however, is the general correspondence in overall patterns. Unlike other aspects of language, sex differences have not been a factor in studies of syntactic language development. We found absolutely no sex differences in this study. A second common pattern is that of consistent and orderly mistakes. Most of the children's grammatical errors appear to be governed by rules and strategies; they are not mistakes of wild and random guessing. Finally, and most significant, there is the common pattern of little development during this age period. While the older children in our lower class group did significantly better than the preschoolers on a few items, the general picture created by our results is hardly a developmental one. Menyuk (1964), in her study of productive speech, found no growth in the use of new transformations during the kindergarten period. She speculates: "One explanation of these trends may be that the kindergarten period is used for the establishment of the correct usage of rules already incorporated in the grammar and the consequence is comparatively less experimentation with language" (p. 545). Berko (1958) also observed this trend between preschool and first grade. With the exception of one item on her test, she states that. "improvement was in the direction of perfecting knowledge they already had" (p. 172).

The second general conclusion to be drawn from our results is a rather disturbing one in light of what we have just said. Clearly, the language

environment of disadvantaged New York City children is adequate for the development of some basic language structures (negation, for example). It apparently is not adequate for the optimal development of others. What are the implications?

A growing volume of evidence (Lenneberg, 1967) indicates that the human race has a unique, inherent capacity for language development which may be limited in its biological foundations to the years of childhood--and that this capacity unfolds in almost any environment to the point of speech onset. From this point on, there are few who would deny that environment becomes an important factor, although its role in syntactic development is still far from clear. Is there a "critical period" for such development? If kindergarten is not a time of "natural" language learning, can children who have not developed basic understandings by this age be helped? If so, how? If not, what are the precise consequences of their handicap? Should steps be taken to help them at an earlier age? These are questions that demand exploration and solutions if we are to guarantee children the most human right of all--that of basic competence in their native language.

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Appendix

Table A

Means, Standard Deviations and Ranges on Subscores and Total Score of the Verbal Instructions Task

Subtest	Means S.D.s Ranges	Low SES Pre-K (N=42)	Low SES K (N=49)	Middle SES Pre-K (N=39)	Middle SES K (N=63)
Negation without, but not	$\bar{X}$	3.33	3.63	3.79	3.86
	S.D.	.68	.56	.46	.35
	Range	1-4	2-4	2-4	3-4
Conjunctions and/or	$\bar{X}$	2.71	2.65	2.79	2.95
	S.D.	.50	.59	.40	.21
	Range	1-3	1-3	2-3	2-3
Prepositions in, on, under, between, across	$\bar{X}$	4.55	5.12	6.56	6.33
	S.D.	1.59	1.42	.67	.71
	Range	1-7	1-7	5-7	4-7
Plural/Singular Indices	$\bar{X}$	3.05	3.49	4.31	4.54
	S.D.	1.02	1.01	.76	.73
	Range	1-5	1-5	3-5	2-5
Comparatives more, less, fewer	$\bar{X}$	1.52	1.71	2.51	2.41
	S.D.	.79	1.03	.90	.95
	Range	0-3	0-4	1-4	1-4
Comparatives big, bigger, smallest	$\bar{X}$	.93	.88	1.15	1.08
	S.D.	.55	.52	.53	.60
	Range	0-3	0-3	0-2	0-3
Total Score	$\bar{X}$	16.09	17.49	21.13	21.18
	S.D.	2.75	3.31	2.21	1.92
	Range	10-22	9-23	14-25	17-26

Table B

Means, Standard Deviations and Ranges on Subscores and Total Score of the Language Comprehension Task

Subtest	Means S.D.s Ranges	Low SES Pre-K (N=41)	Low SES K (N=49)	Middle SES Pre-K (N=39)	Middle SES K (N=63)
Future Tense	$\bar{X}$	2.78	3.04	3.72	3.37
	S.D.	1.02	.85	.60	.70
	Range	1-4	1-4	2-4	2-4
Past Tense	$\bar{X}$	2.46	2.69	3.36	3.06
	S.D.	.63	.78	.77	.81
	Range	1-3	1-4	2-4	2-4
Negation	$\bar{X}$	1.80	1.98	1.95	1.97
	S.D.	.56	.14	.22	.18
	Range	0-2	1-2	1-2	1-2
Comparatives more, less	$\bar{X}$	3.00	3.20	3.59	3.38
	S.D.	.90	.81	.71	.82
	Range	1-4	2-4	1-4	1-4
Comparatives same, different	$\bar{X}$	1.24	1.45	1.87	1.86
	S.D.	.74	.66	.40	.39
	Range	0-2	0-2	0-2	0-2
Time Words before, after	$\bar{X}$	2.07	2.08	2.33	2.32
	S.D.	.93	.85	.94	1.05
	Range	1-4	0-4	1-4	0-4
Total Score	$\bar{X}$	13.36	14.44	16.82	15.95
	S.D.	2.79	2.13	2.10	2.41
	Range	7-18	10-20	11-20	10-20

7 DISCUSSION: COGNITIVE GROWTH IN PRESCHOOL CHILDREN

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This is a most ambitious program of research. It is an attempt to achieve understanding of the cognitive functioning of young children so that an action program may be developed that will ameliorate the deficiencies introduced by what has come to be called social deprivation.

I think it is fair to ask the questions, "Why this particular approach?" "Why Piaget?" "Why not some other framework?" "Why these tasks?" "Why not some other tasks?"

There are various major traditions that might have been followed:

1. The Pavlov-Watson-Skinner tradition.
2. The Pavlov-Hull-Spence tradition.
3. An evolutionary-developmental tradition with concepts analogous to those of developmental biology.

The first tradition is currently well represented by Bijou and Baer (1961) who have defined "psychological development" as progressive changes in the way an organism's behavior interacts with the environment While such a definition, hinging as it does upon the word progressive, would seem to imply a succession of organism-environment interactions, evolving into new modes of interaction, we are assured that what is intended by the word progressive is a succession of response produced changes in stimulation which in turn trigger new responses which in turn further modify stimulation, ad infinitum This definition and the impressive technological array generated by operant conditioning researchers does provide a framework for action programs. The central thesis of this position is that an organism is whatever its controlling environment makes of it.

Developmental considerations play no role since behavioral change is attributed to the external program (Skinner, 1963). Clearly the present program is not in this tradition. And this tradition is not oriented toward differences in modes of cognitive functioning. It assumes invariance of process across ages, social conditions, conditions of pathology, etc.

The second tradition is represented by the Kendlers and by Zeaman and House. The Kendlers conceive of two broad developmental phases, the first characterized by a simple conditioning model, and the second by a conditioning model complicated by mediation. The chief mediator appears to be language (Kendler & Kendler, 1962). With the advent of Verbal Mediation the behavior of the organism changes dramatically.

Zeaman and House prefer to think in terms of an attentional model. When the organism makes the appropriate attentional responses, that is, attends to the relevant dimensions of a task, the task will be readily learned (Zeaman & House, 1963) While the Kendlers' position introduces a developmental flavor, Zeaman and House share the notion of invariance across ontogenesis with the operant psychologists.

The Kendler model would suggest a program which places great emphasis on associating things and possibly relations in the world with appropriate verbal responses.

The Zeaman and House model would suggest a course of training that provides an opportunity to try out and discard successions of attentional responses.

The Kendler model is rather parochial and it is difficult to see how a multi-faceted action program could be derived from it.

The third tradition, as expressed by Piaget and his associates, which guides the present program, may be characterized by the following quotation from Inhelder:

> For it does not seem--and I am here anticipating the interpretation of the facts--as if the growth of knowledge in the child were due exclusively to a cumulative stockpiling of information received or exclusively to the emergence of a sudden "insight" independent of preliminary preparation Rather the development of knowledge seems to be the result of a process of elaboration that is based essentially on the activity of the child (Inhelder, 1962, p. 20)

There are particular qualities and activities that characterize the process of elaboration which is ordered in stages. Each stage is both a formative period and a period of attainment characterized by the organization of a structure of mental operations. Each structure constitutes the attainment of one stage and the starting point of the next The order of succession of stages and structures is constant It is this statement that imparts a developmental quality to Piaget. Ages of attainment can vary, within limits, as a function of factors of motivation, exercise, cultural milieu, etc.--it is this statement that provides the foundation for an action program. Transition from an earlier to a later stage follows a law of implication analogous to the process of integration, preceding structures becoming a part of later structures (Inhelder, 1962, p. 23). But there is very little suggestion for how the process of integration is to be implemented. This is a major handicap in the way of formulating an action program.

There are two types of activities which may provide some leads for action programs: (1) Logico-mathematic activity, the activity of bringing together or classifying, of dissociating, of order, of counting, and so on--any activity for which objects are no more than a support, in short conceptual operations. (2) Activity of a physical type,

> ...an activity of exploration aimed at extracting information from objects themselves, such as their colors, form, weight, and so on. It is thus in acting on the external world...that the child elaborates a more and more adequate knowledge of reality It is precisely the successive forms of his activity in the course of development that determine his modes of knowledge (Inhelder, 1962, p 20)

The four general types of tasks used in the present program, classification skills, time concepts, transformations, and language represent these activities and do provide a potential base for an action program.

In each of the areas rather ingenious techniques have been employed to assess the behavioral characteristics of preschool and kindergarten children from varying cultural backgrounds. The general outcomes are that older children do better than younger ones and that white middle-class children do better than Negro or Puerto Rican lower-class children. This is certainly what one would expect. What now is required is to analyze these outcomes so that a clearer picture of process is forthcoming. Most of the papers have not attempted to do this. The language paper has raised the important question of critical periods and the specter that if the lower SES children are not appropriately trained, the time may pass when much can be done for them.

In order to get at process, it seems to me, that the subjects in the study need to be pushed--some pushing is evident but not nearly enough to provide the necessary information for an appropriate action program.

For example, in the object sorting task, perhaps the most useful question to ask is not how does the child sort, but rather is he able to shift from one sorting principle to another: from color to form; from form to function or to a rule. If he is unable to do so, what kinds of experiences are necessary to provide the cognitive skills required? This is an empirical question and must be dealt with as such.

In any event, the analysis ought to pay close attention to how the child passes and how he fails. This applies to all the tasks presented today, not just object sorting. One may fail intelligently and pass stupidly. For example, an intelligence test item in the form of an analogy:

Time: clock:: warmth:_____. (The passing response is thermometer--a failing response is oven.)

But if the child thinks as follows: A clock makes time as an oven makes warmth--is he necessarily inadequate?

Another example--gift: joy:: death:_____. (Sadness is the correct response--life insurance is scored as incorrect.)

Let me present some further examples. Items from a standard test which are frequently passed by retarded youngsters are:

Cats scratch; bees sting.

Brother is a boy, sister is a girl.

Inquiry indicates that both responses may reflect mechanical word association; in the one case, bees-sting, in the other boy-girl.

A child responding: Cats scratch; bees fly--would be downgraded even though his response probably reflects more complex conceptual processes.

The central question is, "How does he do it?" The tasks offered are a good beginning but they must be adjusted to reveal the child's modes of cognition.

There are some design problems which need to be faced. One, accidental, of which the group is aware, relates to the elevated IQ of the middle-class pre-kindergarten group and can probably be dealt with by appropriate statistical and sampling adjustments.

The second, of which the group is also aware, is more serious. It has to do with the confounding of social class with race or ethnic character. Here, the concern is not with genetic factors per se, although they may play a role, but rather with the correlation which is bound to exist between ethnic-racial differences and cultural factors. These may be quite subtle and difficult to pinpoint but one would hope that a Negro middle-class sample and a white lower

socioeconomic group might be investigated. The test materials are likely to reflect white middle-class biases despite stringent efforts to avoid such influences. They are unavoidable and their impact is difficult to assess unless the design problem is dealt with.

An obvious line of inquiry is presented by the array of individual differences in each group. Just what are the factors that contribute to the high performance of some low SES children and to the low performance of some high SES children? No attempt appears to have been made to investigate this facet of the data. An investigation along these lines might provide key information for an action program. While some high performance low SES children may be particularly well endowed others may have had key experiences which contributed to their superior performances. If such experiences could be identified they might provide important leads for an action program.

Another aspect of the study which has not been reported has to do with inter-task consistency. Are the children who do well in one task likely to do well in other tasks? The most meaningful way to look at this question would seem to be within age and SES categories. Some interesting interactions may be forthcoming. For example, relatively poor cultural experiences may prove to be sufficient for adequate performance in some task areas but not in others whereas somewhat more enriched nonspecific experiences may have more general effects.

As this program moves into its action phase it must become a study of transfer. That is, how do the treated children respond in areas, and with materials, other than those specifically employed during initial training? How long do the effects persist? Are there certain cognitive masteries, such as the conservation principle or those dealt with in the time studies, or the transformation

studies, or the language investigation, which are progressive and irreversible and which open new avenues of cognitive opportunity?

I have not attempted to deal with the specifics of the excellent papers presented by the group. It would be a disservice to try in so short a time. The raw material is here. The baselines are established. The task of converting this information into an effective action program is formidable. The subjects are in many ways so alien in their cognitive operations that mere adult investigators are often confounded and misled. For example, the five-year-old who asks his father, "In the war were you a German or an American?", or what is even more nettling, "Dad, did you get dead in the war?"

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